McGraw-Hill Publishing Company, Inc. APRIL, 1934 Price 35c. per copy

AVIATION

The Oldest American Aeronautical Magazine

IN THIS ISSUE

DESIGN AND PRODUCTION

Application of flush riveting in a large flying boat, page 106

Will cruising condition become the design criterion for transport planes? page 110

How much overload will a modern high speed transport plane withstand? page 109

Airplane and engine specifications brought up to date, page 122

Speed and load carrying for low power output, page 127

Low frontal area characterizes a new series of engines, page 128

Can a converted automobile engine be used in an airplane? page 128

TRANSPORT

How Colonel Lindbergh applied celestial navigation on his recent flight page 102

What may we expect from Congress in air mail legislation? page 99

What transport planes are available for purchase? page 122

How are cruising limitations set up by transport operators? page 110

Is the air transport industry to be regulated by a federal commission? pages 99 and 113

MILITARY

What are the problems confronting the Army Air Corps in flying the mail? pages 114 and 117.

What routes are being served under the restricted air mail schedule? page 118

How is Congress progressing in the investigations of Army and Navy aircraft procurement? page 118

PRIVATE FLYING

What are the specifications of airplanes and engines for private use in 1934? page 122

An airplane for less than $1,000, page 128

What British engine is to be available for sale in America? page 128.

Published monthly, price 35c. a copy. Subscription rates—United States, Mexico and Central and South American countries, $3.00 a year. Canada, including duty, $3.50 a year. All other countries $5.00 a year or 24 shillings. Entered as second-class matter July 29, 1919 at Post Office at New York, N. Y., under the act of March 3rd, 1879. Printed in U. S. A. Cable address: McGrawhill New York. Member of A.B.C. Copyright 1934 by McGraw-Hill Publishing Company, Inc. 330 West 42d Street, New York, N. Y.

AVIATION

Established 1915   McGraw-Hill Publishing Company, Inc.
THE OLDEST AMERICAN AERONAUTICAL MAGAZINE

Edward P. Warner, Editor   *Louis A. Stoll, Vice-President*

Leslie E. Neville, *Managing Editor*
S. Paul Johnston, *Associate Editor*
David J. Leask, *Art Director*
Paul Wooton, *Washington*

★

Contents for April, 1934

Volume 33, Number 4

★

McGraw-Hill Publishing Company, Inc., 330 W. 42d St., New York, N. Y.
Branch Offices: 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, Aldwych, London, W. C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Greenville, S. C. James H. McGraw, Chairman of the Board; Malcolm Muir, President; James H. McGraw, Jr., Vice-President and Treasurer; Mason Britton, Vice-President; B. C. Parmelee, Vice-President; Harold W. McGraw, Vice-President; B. R. Putnam, Secretary.

Printed by The Schweinler Press, N. Y.

All Weather Aviation Mobilgas in the Tank... "Adsorb" Mobiloil Aero in the Engine

SURE SHE'S OKAY Okay to take the air without cough or spit Okay to skim the ceiling, ride a storm, cross a mountain range, span a desert Because she's gassed up right Oiled up with the best there is

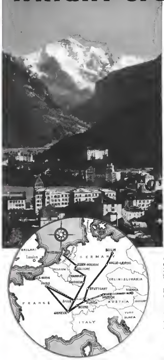
Aviation Mobilgas—the modern aviation gasoline with "Climatic Control"—keeps the motor purring at its best Blow hot or cold, wet or dry, heavy ground air or high-altitude light!

In the engine—Mobiloil Aero—with the improved "*Adsorb* Property" It clings to cylinder walls, actually permeating the minute pores of the metal To maintain a permanent lubrication film even after the engine stops Which means less starting up wear More hours between overhauls

Take on a trial filling of both Mobilgas and Mobiloil Aero Try out Mobilgrease on your rocker arms too And Mobiloil Aircraft Instrument Oil and Gargoyle Compass Fluid See what a difference they make

Mobiloil & Mobilgas
SOCONY-VACUUM CORPORATION

WRIGHT CYCLONES *power the*
LATEST EQUIPMENT
of
SWISSAIR



AIRLINES OPERATED BY SWISSAIR

CURTISS-WRIGHT CONDOR

GENERAL AVIATION GA-43

SWISSAIR, the fastest airline on the European Continent, operates hu
dreds of thousands of miles annually over the picturesque Alp
Mountains Wright Engines are standard power equipment of this a
line—chosen for their dependable service and economy of operatio

In 1929 SWISSAIR purchased a fleet of tri motored Fokker mo
planes powered by Wright "Whirlwinds" SWISSAIR inaugurated
express service between Zurich, Munich and Vienna in the spring
1932—with single-engine Lockheed Orion monoplanes powered
575 h p. Wright "Cyclones." Schedules on this high-speed service h
been maintained for two years with striking regularity, without ac
dent or even a forced landing—a tribute to the reliable performa
of the Wright "Cyclones."

The latest types of SWISSAIR equipment are powered by 700 h
Wright "Cyclone" Engines. The 17-place Curtiss-Wright Condor a
the 11-place General Aviation GA-43, scheduled to be placed
service this spring, will again increase the passenger, freight a
air mail facilities of SWISSAIR—one of the world's leading airlin

WRIGHT
AERONAUTICAL CORPORATION
PATERSON NEW JERSEY
A DIVISION OF CURTISS-WRIGHT CORPORATION

AVIATION
FOR APRIL, 1934

Air Mail Legislation in the Making

Congress debates new codes full of startling features

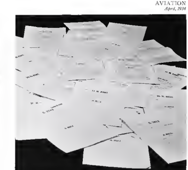
WHATEVER may come out of the present confusion of counsels on the subject of air transport, at least one thing is certain We are about to see the execution of another fundamental change in air mail policy and in the basis of the financial relations between the transport lines and the government. These great landmarks seem to be destined to arrive approximately at three-year intervals The first was the Kelly Act of 1925, that first made it possible for commercial airline operators to get some kind of financial encouragement from the government The second major modification was the route certificate act of 1928, recognizing the principle that there must be a substantial guarantee of continued government assistance over a much longer term than that of a four-year contract if properly equipped and properly organized transport systems were to be developed Next came the Watres Act of 1930 changing the system of compensation for carrying the mail and giving the Postmaster General a degree of freedom that enabled him to encourage and to compensate provisions for carrying passengers on mail lines and allowed him also to discriminate among would-be operators with a view to recognizing the rights of pioneers in the field and to give well-organized enterprises, manned by personnel of demonstrated experience and competence, a preference over new-born promotions Now it is 1934 and new legislation based on the experience accumulated since 1930 is perhaps already overdue For more than a year new plans have been in the making, the subject of painstaking study by the Post Office's Committee of the House of Representatives but with the dramatic gesture of contract cancellation on Feb 9 the time for painstaking deliberation came to an end Manifestly if we are to have any air mail service at all, or any other kind of air transport, we have to get some new legislation without further delay Both Houses of the Congress have been forced to start a high-pressure consideration of the subject.

A storm of bills

From Feb 10 to March 10 there have been introduced some 40 air mail bills. Most of them have about as much chance of survival as a snowflake falling to the ground in the last unseasonable flurry of spring The Kelly bill of a year ago has reappeared in a dozen forms, with as many different Congressmen's names attached and embodying every conceivable combination of pound-mile rates of payment upon every sort of a sliding scale From the whole mass there originally stood out one measure of transcendent importance outstanding because it represented the apparent present desires of the President as recorded in his letter of March 7 to the chairmen of the responsible committees of the Senate and the House of Representatives. Within 48 hours after receipt of the letter identical bills had been introduced into the two houses (in order that hearings might start in both places at once) The House bill bore the name of Mr Mead of Buffalo, N Y, chairman of the Committee on Post Offices and Post Roads The Senate version, identical in text, is remarkable in that it appears under joint sponsorship, the credit for its appearance split two ways between Senator McKellar of Tennessee and Senator Black of Alabama. Senator McKellar is chairman of the Senate committee dealing with postal affairs, and although he was one of the warm advocates of the Watres Act at the time of its passage and showed a particular interest in the possibility that the Postmaster General's privilege of extending lines might be used to create a new air mail route through his (Senator McKellar's) state he has since become a pronounced sceptic on the necessity of maintaining air mail appropriations at anything like the accustomed level Within the past few weeks he has been one of the most energetic upholders of the Postmaster General's action in cancelling the air mail contracts, and has lost no opportunity of expressing his conviction that fraud and collusion had been amply proved and that no further discussion on those points was in order His colleague in the sponsorship of the new legislation, Senator Black, needs no introduction to anyone interested in aviation As chairman of the special committee that has been engaged in an unremitting search for the appearance of evil in American air transport over a number of months past, popular assumption gives him a large share of the credit for having persuaded the Administration that summary action should be taken on Feb. 9 without waiting for the employment of any of the ordinary processes of law.

Administration proposals

The most conspicuous features of the Mead-McKellar-Black bill are (1) a provision for a completely new deal on air mail, with a rewarding of all contracts by competitive bidding and with the previous operators not only receiving no especially preferential consideration but actually put under unique handicaps, (2) an opening of all routes to the widest possible competition through allowing the recipient of a contract six months after the date of its award before having to start operations, (3) the transfer, at the end of three years, of authority over air transport and of the power of decision relative to air mail contract awards and payments to the Interstate Commerce Commission (4) an elaborate code of limitations upon the action of the Postmaster General, to prevent him from doing any of the things of the doing of which in the past the Administration has disapproved, (5) the complete disassembly of all holding companies or mergers involving airline operation, and in particular the issuance of a final decree of divorce between the operation of lines and the manufacture of equipment, (6) the penalization by permanent banishment from the industry of all persons having been at any time involved in "any combination to prevent the making of any bids for carrying the mails" (and without specification of the way in which such involvement is to be determined), (7) the limitation of the compensation that any individual may ever at any time receive from air transport operations to a maximum of $17,500 per year from all sources combined (though even in the lowest depths of the present depression the government allows a maximum of $60,000 a year to railroad officials), (8) a fixing of the salaries and terms of employment of pilots and co-pilots by the Secretary of Commerce, (9) an interlocking of commercial and military aviation through requiring that the Secretaries of War and of the Navy shall participate in determining the type of equipment that is to be used on air mail lines, through a demand upon all air mail operators that they shall whenever requested carry pilots of the Army, Navy, or Marine Corps (including the Reserve) as co-pilots on their ships, and through a stipulation that all pilots holding Reserve commissions may have leave of absence for a month out of each year to go on active service, (10) a prohibition of the upbuilding of any large-scale transport systems, through provisions that no contract may ever be sold or transferred, that no contractor may hold any of the stock of any other mail-carrying company, and that no one company shall hold any two contracts on routes of major importance even though the two be absolutely non-competitive (it is even prohibited that a contractor on a major route shall own any of the lines serving as feeders of that route) (11) that the air mail postage rate shall be lowered to a flat 5 cents per ounce (which everyone applauded, and which almost everyone wanted to see amplified by arrangement for a 3-cent "diagram")



"From Feb 10 to March 10 there have been introduced in the House and Senate some 40 air mail bills. Most of them have about as much chance of survival as a snowflake falling to the ground in the last flurry of spring."

In the course of the hearings, with an impressive array of witnesses including Lindbergh and Rickenbacker and Clarence Chamberlin and Amelia Earhart and executives and pilots of transport lines, both mail-carrying and independent and a miscellany of presumed experts on air transport and people with schemes to push, it became quite apparent that the responsible committees as a whole had no fixed bias in favor of the bill as originally drawn and no intention of rushing it through. It became apparent that a substantial proportion of their membership had either conceived on their own account or been brought to believe as the result of the testimony offered that some of the provisions of the bill were unworkable and that others were outrageously unfair, and there developed a heartening assurance of substantial amendment before final passage. It is difficult to pick out a few names among many, but Senators Logan of Kentucky and O'Mahoney of Wyoming (both Democrats) and Barbour of New Jersey and La-Follette of Wisconsin, and Congressmen Mead (chairman of the House Committee) and Kelly (long famed as a student of air mail and a thorough expert on its workings) were among the most actively interested and among the most helpful of cross-examiners and the most sympathetic of listeners to any specific criticisms of the original draft and arguments in favor of amendment.

Despite the probability of substantial change in the original bill, it serves as a point of departure and as a record of the original desires of the Administration and its apparent spokesmen in Congress. Some of its provisions, such as the one dissociating operation from manufacture, are almost certain to survive in permanent legislation. Others, such as the extremely severe limitations on the future participation in mail contracting of companies that have held contracts in the past, are almost sure to be amended. In a discussion of some of the sections of the bill and of their possible consequences we are taking occasion also to mention from time to time the criticisms that have been made by witnesses on the several points and the probability of consequent amendment of the bill and the probable nature of such changes. There is unlikely to be any final agreement before April 15.

[Just as we are on the point of going to press Senators McKellar and Black introduce a new bill, making minor modifications in the original draft. Most of the provisions that seemed to make the original bill unworkable have been retained in the revision. The most outrageously unfair item in the original form that prohibiting any bidding by any company which at the time had a claim against the government on account of cancellation of a previous contract, has been cut out, but it has been replaced by an equally astonishing specification that all individuals regardless of individual guilt or innocence who participated in the Post Office Department conferences in 1930 are to be henceforth debarred from any connection with the air mail. The new bill explicitly authorizes the Interstate Commerce Commission to grant three-year extensions of contract, and it proposes a postage rate of 6 cents instead of 5.]

New low in rates

The competitive bidding provisions set limitations on compensation which go far below anything that has ever been suggested in all the pound-mileage rate discussions of the past. The maximum allowed in any bid would be 30 cents per mile for carrying 300 lb. of mail, and 6 cents at the outside for each 200 lb. thereafter. The pound mileage rate would thus be a maximum of one mill on 300 lb. and 3/10 of a mill above that mark, as against the 2 mills that has generally been considered as fairly compensatory and the ½ mill that is the minimum limit to which most of the sliding-scale schemes of the past have proposed to descend after the amount of mail carried has reached a very high level indeed. A further check is supplied by an absolute limitation to an absolute maximum payment of 40 cents per mile, even though the amount of mail put on a plane by the government should run up to a ton and completely displace the passengers who might otherwise be carried. The unfairness of this provision having been protested by many witnesses the responsible committees have appeared to agree that some liberalization or even the total elimination of a maximum would be desirable. As a further insurance that no one shall be able to make out of air transport any profit that may be regarded as excessive, the competitive bidding provisions of the bill are supplemented by specific authorization to the Postmaster General to audit the books of each contractor and periodically to reduce their rates of payment by executive fiat if in his opinion the "public interest" justifies it. The contractor would not even have the somewhat tenuous protection provided by the provisions heretofore existing that the periodic readjustments of compensation should be arrived at by negotiation between the representatives of the government and those of the contractor,—a provision which, of course, has not prevented the making of many very substantial reductions in the rate of mail pay over the past four years.

Fragmentary air transport?

Though the draft does not go so far as to describe an air mail map in detail, it does provide that there shall be at least three transcontinental routes extending substantially from coast to coast. It seems to have been the clear intention of the Congressional sponsors of the bill, or at the very least the impression of most of the members of their committees, that these trans-continental routes would be let as units. Officials of the Post Office Department, however, have astounded and agonized the bulk of the aeronautical world and certainly surprised a number of the committee members by asserting the superior desirability of breaking each trans-continental route into several fractions and contracting for each segment separately and with a different carrier. Plenty of witnesses have come forward to protest the virtual certainty of an alarming loss of efficiency and increase of cost by any such dissection of long-haul routes.

Commission government

Though the language is not entirely clear, it seems to be the general understanding among those in best position to interpret the meaning of the bill that the three-year contracts now to be let would in effect be carried forward indefinitely by the issuance of certificates of convenience and necessity that would be the essential equivalent of the route certificates and route warrants heretofore issued. The major change proposed would be in a granting of the new certificates three years hence by the Interstate Commerce Commission rather than by the Post Office Department. Upon that point the representatives of every aeronautical interest joined in acclaiming the expressed purpose with a unanimity rare in aeronautical history. Apparently everybody, whatever position he may have taken on past practices in awarding mail contracts now wants to get the matter out of the political sphere and into the hands of a non-political and more or less judicial body.

There was, however, some little objection, in fact a good deal, to tossing the problem into the lap of the Interstate Commerce Commission. That body already has about all that any one agency can do to handle the railroad. It also includes no aeronautical specialists among its present membership and it was urged that there should either be a separate panel of the Interstate Commerce Commission created specifically and exclusively for aeronautical matters and staffed by men with aeronautical knowledge or that there should be set up a wholly new aviation commission. To that objection and recommendation, too, the committees listened with sympathetic understanding and with evidence of some degree of acceptance of the argument.

Aside from a proposal that some other body could better do the work, aeronautical witnesses confined themselves to expressing regret that it should be considered necessary to wait three years and to voicing with varying degrees of fervor their wish that a commission might take the matter over upon the moment. Some progress was made in that direction when Senator O'Mahoney of Wyoming, lately First Assistant Postmaster General and now a member of the Post Office committee introduced a bill of his own. The O'Mahoney bill, offered as at least a partial alternative to the McKellar-Black measure and having the pledged support of several Democratic members of the Post Office Committee besides its author, undertakes to eliminate entirely the subsidy features of air mail, to allow the allocation of the mail among all available air lines and to pay compensation for carrying it fairly remunerative for the services performed, and to transfer all responsibilities in connection therewith from the Post Office Department to the Interstate Commerce Commission at the very earliest moment at which the Commission can get ready to receive them.

[A last-minute development is the introduction of an entirely new measure by Senator McCarran, junior democratic member of the Black Investigating Committee. Senator McCarran proposes to carry the commission idea still further and in still closer harmony with recommendations of expert witnesses by providing for a new air transport commission of five members to be charged with the supervision of all air mail finances. The McCarran bill further proposes the elimination of competitive bidding, with awards made by the newly-created commission to the operators best able to perform service and compensation on a pound mileage basis and on a sliding scale. It still further eliminates the penalization of individuals engaged in air transport in the past, while preserving the prohibitions on interlocking directorates and on manufacturing affiliations.]

Next to the suggestion that a commission should come into the regulatory field, and the Post Office Department recede into the background, the section of the McKellar-Black bill commanding most general support was that which authorized the governmental fixing of maximum flying hours and minimum pay for pilots and co-pilots. There is general agreement that that matter ought to come out of the realm of constant bargaining and possible periodic warfare and be put under government supervision, preferably under the control of the same agency which will to a large extent fix the income out of which the pilots' salaries must be met.

This is the second of two articles on the 1933 survey flight of Col. and Mrs. Charles A. Lindbergh, written by Commander Weems and based on information furnished by Colonel and Mrs Lindbergh. As in the first article, Commander Weems has also drawn on such sources as Pan American Airways, of which Colonel Lindbergh is technical advisor, and the American Museum of Natural History, to which the airplane and its equipment has been presented. This concluding installment is devoted largely to a discussion of the long over-water sections of the flight and the equipment used in celestial navigation.

The Flight of The "Tingmissartoq"

The authoritative account of the 1933 survey flights of the Lindberghs

By Lt.-Comder P. V. H. Weems
U.S.N. Retired

ON THE long over-water flight from Bathurst to Natal, Dec. 6, 1933, full use was made of dead reckoning, radio, and celestial navigation. Unique problems were met and successfully solved. British Admiralty Mercator Charts of the South Atlantic ocean (scale 1 7 727 000) were used on this leg, Chart 2060A for the eastern section, and Chart 2060B for the western section. It was found that a straight rhumb line on these charts in low latitudes was sufficiently close to the great circle for practical purposes. As usual, the plotted course was divided and marked for 100 knot intervals. The true and magnetic courses were written directly on the charts.

The charts to a convenient Mercator scale showed the variation for every two degrees, as well as islands and the contours of the shores of Africa and South America. Lines of position obtained by radio or by celestial navigation, were plotted directly on the chart.

Wind forces neutralized

The latest weather charts indicated a northeast wind near Africa, and a southeast wind near South America, with the force and direction of the wind in each case nearly equal and fairly constant. Since the weather was about normal, Colonel Lindbergh estimated that the wind drift on the first half of the hop would be compensated by the opposite wind in the last half. It turned out to be about that way, though of course he does not recommend this as a fixed rule.

The compass course was therefore set allowing for the variation and the deviation, but making no allowance for the wind. The first sextant observations showed the plane to be about 40' south of the route, but no alteration was made to get back on the course. Later, another series of observations were taken near the island of St Pauls Rocks, which was not far from the destination. The position from these observations showed the plane to be nearly on the original course. At this time, however, Mrs Lindbergh got a radio bearing from the S.S. Westfalen. The plane's position had been definitely determined by celestial navigation and the strength of the signals indicated the Westfalen was near the plane on the port beam. It was therefore decided to turn sharp left and follow the radio bearing until the Westfalen was sighted. After flying about 40 miles on a southerly course, the ship was sighted, after which a new and direct course was set for Noronha.

Radio and celestial navigation

Colonel Lindbergh states that on these long flights a sextant is essential. Also, by using lines of positions obtained by radio as well as those obtained by celestial navigation, he definitely places these sole means of position finding over water in the category of practical air navigation. In theory, this has been known and perhaps used to a small extent yet, in the knowledge of the writer, this flight is the best example of finished practical air navigation. Incidentally, it was found that greater accuracy in the use of the sextant was possible when the plane was steered by the directional gyro than when it was steered by the magnetic compass. It is possible to hold the plane much steadier in the former case.

Team work on the flight

The many duties in flight were about evenly divided. The principal tasks were piloting the plane, operating the radio, taking drift and ground speed observations, taking and reducing celestial navigation observations, and keeping the log of the plane. These duties were divided differently than on the other outstanding navigational flight—that of Wiley Post and Harold Gatty. Post did nothing but pilot the plane, and Gatty did nothing but navigate. In fact the Winnie Mae was not fitted for dual controls and communication between Post and Gatty was done by voice tubes and by written notes on a string. Furthermore, little attention was given to, and no practical benefit derived from the use of radio, and therefore more time was devoted to dead reckoning and celestial navigation. As a matter of fact, part of the difference between the two flights may be accounted for by the different missions of each.

The Tingmissartoq was fitted with dual controls, the two cockpits were connected, and both the Colonel and Mrs Lindbergh were capable of doing any of the work involved. Actually, however, it was logical to make a clear cut division of duties, and this was done. Colonel Lindbergh did most of the piloting, and was relieved at the controls principally to permit him to take sextant observations and to reduce the observations to positions and in some cases to make notes and to work on the charts. Mrs Lindbergh did all the radio sending and receiving in code, made all drift and ground speed observations, kept the official log of the flight, and handled the controls when the Colonel was otherwise occupied.

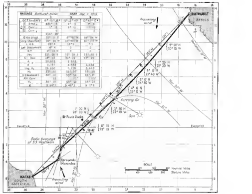


Chart showing the course of the "Tingmissartoq" on the South Atlantic Crossing. The drawing was prepared and the calculations reproduced from the original which is now included in the exhibit of the plane and its equipment at the American Museum of Natural History. (Errata Note: In reproducing the calculations the differences between Hc and Ho were omitted. The missing column should read: a—16t—64t—20t.)

Some details of navigation

The accompanying chart shows some of the navigation accomplished on the Bathurst-Natal flight. No trick methods or "gadgets" were used on the entire flight. The navigation was not hurried and standard time-proved methods were used. Several celestial observations were made for each line of position shown. A wrinkle was adopted to avoid the usual tedious calculations for getting the average of ten or more observations. Adding several times and the corresponding altitudes in arc, then dividing them to obtain the average, is a difficult operation; in fact, it is the most tedious part of the calculations. Colonel Lindbergh assumed that if he could get as many as three successive altitudes taken at equal intervals of time, that the results of any of the three would not be far out. It was also found that intervals of about one minute were convenient and practicable. In smooth air it was comparatively easy to get three consistent successive observations but in bumpy air more observations had to be taken in order to get a string of three good sextant altitudes. When finally satisfied with the observations made, one of the three sights was worked out, the line of position plotted, and necessary changes in the navigation made. Finally, as a check one of the remaining sights was worked independently, though the resulting line of position was not plotted. In no case was it found necessary to alter course after making celestial observations. It was not even found necessary to alter course because of drift and ground speed observations, as on each leg of the flight the wind was known sufficiently well to set an accurate course at the time of take-off, and the compass and directional gyro offered an accurate means for steering the desired course.

As Colonel Lindbergh expressed it, one should expect to reach the destination by straight dead reckoning, while radio and celestial navigation give additional factors of safety, reassurance, and a definite check on the navigation in flight. Although any one of the three available methods suffice under good conditions, the additional two methods surely provide a reasonable factor of safety under most conditions. In stating how nicely the dead reckoning worked out, Colonel Lindbergh repeatedly stressed the essential need of both the radio and the sextant. A finished navigator will require and utilize all three methods.

Long range radio

On the Bathhurst-Natal hop, Mrs Lindbergh was in communication with the Pan-American radio stations when less than one hour from Africa. Following are samples of the messages (received by Pan-American station at Bahia):

10 00 GMT Lat. 2°—50' North Long 27°—10' West Course 224° True. Altitude 1 200 ft

11 P.M. E.S.T.—'Position Lat 11°—00' N. Long. 19°—05' W. All well

1 2' A.M. E.S.T.—'Sky ½ overcast.

Scattered squalls, visibility 8 miles All well

1 50 A.M. EST—"All well.'

2 00 A.M., EST— Position Lat. 7°—35' Long 22° 30' W Course 224°, sea calm wind O Frequent squalls Altitude 1,000 ft.

3 10 A.M EST—"8 A.M. GMT (3 A.M. EST) 5° 15' N., 23°—49' W Course 224° TR. Frequent squalls Visibility unlimited. Sea calm Wind O Altitude 1,000'"

Port of Spain—San Juan

On the flight from Port of Spain, Trinidad to San Juan, Puerto Rico, 752 miles, the navigation was relatively simple. It was thought advisable, however, to keep an accurate record or log of the dead reckoning navigation, then in case of an unexpected rain squall, or a forced landing, the plane's position would be known with reasonable accuracy The following notes appear on the *British Admiralty* Mercator Chart 2060B used for this leg of the flight

"18 Miles East Grenada lite at 13 47
Over Carriacou Island at 13 59
Passing 8 miles west Bequia—14 28
Passing 5 miles west Port Castries at 14 07
18 30 passing 8 miles west Southern of Dominica
8 Miles west South End Guadaloupe at 15 58
2 miles west Montserrat at 16 35
20 miles 225° from Saba I at 17 09
5 miles 45° from East End St Croix at 17 28
Over St. Thomas at 17 50
Land S J (San Juan) about 18 35"

Other sections of the flight

Dead reckoning and radio were used for navigation over land and on the short over-water hops to Europe On the Lisbon-Azores flight of more than a thousand miles effective use was made of all three available methods

An additional need for all available means for safe navigation on the Lisbon-Azores hop was the fact that the weather was not good and that due to the long distance to be covered, it was not feasible to turn back once the plane had passed mid-distance If under these conditions there was a low fog in the vicinity of the Azores, sextant observations would provide a reassuring check in making a land-fall During the flight there was a high wind, and too much haze during the first half making it impossible to take sextant observations on natural horizons Therefore, bubble sextant observations were made which gave an accuracy to within 20 miles. This might appear rather large, but it was sufficiently close except for making a land-fall As Colonel Lindbergh explained it, he would have been disappointed not to get closer results, but an error of even 50 miles in the middle of a flight would not cause a great loss of time This might not be as accurate as some may wish, but he did not need extreme accuracy under these conditions of the flight. If the hop is short, celestial navigation is not needed, if the hop is long then a comparatively large error at mid-distance in the flight would not cause much loss of time

When about half way to the Azores Colonel Lindbergh took several sextant observations of the sun in order to get three consecutive consistent ones Since radio weather reports gave about 4 visibility at the Azores and did not indicate it was getting worse he could depend on getting sun observations to make a land-fall When about 200 miles from the Azores two more observations were made on the natural horizon The dead reckoning course was not altered, yet celestial navigation gave checks on the navigation which were reassuring Actually, in each case the dead reckoning navigation was sufficiently close, yet one cannot trust to it alone

The next use of celestial navigation was on the flight from Ponta Delgado to Las Palmas There was a tail wind on this flight On approaching the Madeira Islands a sun line of position using the natural horizon indicated that the island was in sight although the plane was not yet due there The island was sighted considerably before it was expected indicating a strong tail wind

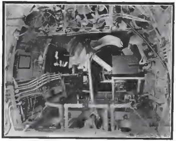
On the Bathurst-Natal hop a series of sextant sun observations were taken when about 700 to 800 miles out from Bathurst. The weather was good, and the natural horizon was used throughout this 1,800 mile hop At first, the observations gave a check on the course, and then later on the latitude was obtained as the sun moved from east to south

The heavy Hydrographic Office Charts of the oceans when folded were sufficiently stiff for use without a separate chart board. This saved weight and still provided reasonable convenience A small 180 deg. protractor was used for laying courses and measuring angles

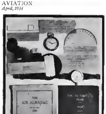
Celestial navigation equipment

More effective use was made of celestial navigation than on any previous flight by plane with the exception of that of Post and Gatty, when Gatty used it extensively and even made night land-falls in Siberia by means of the star altitude curves. The latest equipment was used and, on the Lindbergh flight due to the long over water jumps and the island flying, was essential As Lindbergh points out, celestial navigation has its greatest value in just such flights as this—on long distance, unscheduled flights, with difficult land-falls at the destination While a complete outfit for accomplishing celestial navigation was carried on the flight to the Orient, the over-water distances were short with the result that this equipment was needed primarily to determine the plane's position in case of a forced landing The 1933 flight was the first Lindbergh made on which he considered this method indispensable

The principal items of celestial navigation equipment are the sextant, timepiece, almanac, and means for converting observations to position The Air Almanac and the Line of Position Book were used as the last two items The extended tables for the Line of Position Book for Latitudes 60 to 90 deg were carried but not used The Pioneer octant was chosen because of its compactness and mechanical construction



Looking aft in the 'Tingmissartoq' There was no separation between the cockpits and it was possible for most of the duties to be performed by either occupant



Celestial navigation equipment used in the longer over water stretches of the flight The arc-reading and second setting features of the Longines watch were designed by Colonel Lindbergh and the writer respectively

The Astigmatizer was not used The instrument used proved entirely satisfactory except for the fact that the bubble element gave trouble and interfered with observations made on the natural horizon This is no new complaint In fact, the construction of a bubble element which will not leak has proved to be a problem for all bubble sextant manufacturers

There have been repeated attempts to make a satisfactory adjustable bubble, but without entire success to date Actually what is needed is a *fixed* bubble which requires no time for adjustment in the air That the construction of such a bubble is possible is demonstrated by the fact that Ellsworth is using a Bureau of Standards Type Aircraft Sextant, made on the original government order in about 1925, which still has the original fixed bubble This is an important item and should receive the serious attention of sextant manufacturers As it stands, the aircraft sextant is the weakest link in celestial navigation

Special watches used

The time-pieces used consisted of one arc reading second-setting Longines watch, one second-setting Waltham watch, and one eight-day Longines watch with a 24-hour dial to keep track of the date in high latitudes

The first two watches gave excellent service The eight-day watch did not have an accurate rate although an attempt was made to get an even spring tension by winding it to the 24-hour mark on the wind indicator and then by letting it run to the 96-hour mark before rewinding Both the Longines and the Waltham watches give remarkable accuracy when it is considered that they were subjected to varying temperature, pressure and moisture as well as to the vibration of the plane The watches maintained their proper rate to within a fraction of a second per day—a truly remarkable performance The arc-reading feature was designed by Lindbergh himself, and is combined with the second-setting feature designed by the writer As Lindbergh points out, his arc-reading watch and my sidereal watch have both been reduced in value by the publication of the Air Almanac for 1933, since it gives the Greenwich hour angle direct without the necessity of finding the equation of time, right ascension or sidereal time The only need for the sidereal watch when the Air Almanac is available is with star altitude curves, and these were not carried on the 1933 flight as no night flying requiring their use was contemplated, though Lindbergh states that these would be carried under other conditions

The Air Almanac, designed by the writer, and published by the Naval Observatory for 1933, proved the most helpful of any tables except those in the Line of Position Book Lindbergh states that the Air Almanac is a great improvement over the Nautical Almanac Most unfortunately, the Air Almanac was discontinued in 1934, though some of its features in emasculated form are included in the 1934 Nautical Almanac It is vital to the aviation world that this publication be continued in fact, if the Naval Observatory cannot undertake its publication, some other agency should

For those not acquainted with the principles of celestial navigation it might be briefly stated that a line of position with the same value as a line of bearing obtained from a radio station may be determined by comparing the measured sextant altitude of a celestial body with the computed altitude of the body The marine type sextant may be used when the sea horizon is visible, but for use without the natural horizon, we have the bubble sextant which has its own horizon in the form of the bubble similar to that in a spirit level The altitude of the observed body is computed by solving the spherical triangle formed by the earth's pole, the point on the earth vertically under the body, and the assumed (approximate) position of the observer Data for the convenient solution of the triangle is afforded by the accurate time of observation, by special tables for making the calculations, and by the Government Almanac which gives the latitude (declination) and the longitude (hour angle) of the point on the earth vertically under the body The observer is *toward* the body by the number of minutes of arc or sea-miles by which the observed altitude exceeds the computed, or *away* from the body by the amount the observed altitude falls short of the computed altitude.

In the past, the tedious computations required and the difficulty of taking sextant altitude observations of sufficient accuracy prevented the wide use of this means for fixing the plane's position. With modern simplified tables, improved sextants and time-pieces, and steadier planes due to better steering, the method, while not easy, is entirely practicable as has been demonstrated by this and numerous other flights

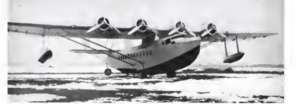
Speed simplifies navigation

Lindbergh points out that the high speeds of modern planes greatly simplifies the problem of navigation, especially wind-drift problems, since the relative wind effect decreases with an increase in the speed of the plane. In the past some people have based the design of planes on an optimum of speed in still air, whereas service conditions are not met in still air In fact, schedules and designs should be based on factors which allow for maximum ordinary winds

Thanks to improved panel instruments the air speed, altitude, and true course are known fairly accurately When traveling at high speeds with all these data accurately known, the effect of the wind becomes relatively less, and, in very low winds, may be ignored for practical purposes on flights up to several hundred miles If, under these conditions of high speeds and accurately known courses and air speeds, we make reasonably accurate drift observations, the dead reckoning becomes very simple In practice, Lindbergh states the air navigator ought to plan on reaching the objective by dead reckoning alone, and under good conditions this should be done However, except when aiming for a large objective, such as a continent, there is urgent need for an additional check When flying to an island there is special need for means of definitely fixing the plane's position The only means for determining position over water is by radio or by celestial navigation and, since each of these methods fails under certain conditions, it is highly important that the air navigator master both methods The best assurance of success is the mastery of both radio position finding and celestial navigation

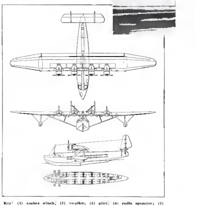
A new Super-Clipper for Pan American Airways

More About The Sikorsky S-42



OVER two years ago, with the launching of the first of the now famous Pan-American Clipper Ships (see AVIATION, October, 1931) the initial steps were taken toward the goal of regular heavier-than-air transatlantic service. The S-40's, although a tremendous advance in size and weight over anything previously built in this country, were admittedly not the ultimate in trans-Atlantic flying boats but represented an intermediate stage in the evolution of the inter-continental liners of the future. Three units were built and proved preeminently successful in plying the Caribbean airways. Day in and day out under all sorts of conditions their performance was carefully studied and recorded. When, a year or so ago, the time came to write specifications for the next step toward the Atlantic services, the lessons learned with the S-40 proved invaluable. Thus the S-42 emerges from the factory and enters upon her flight trials backed not only by years of successful design and manufacturing technique by the Sikorsky group of engineers and craftsmen but also by over six years of operating and maintenance experience under the close supervision of Pan-American's staff and operating engineers.

Although in performance and carrying capacity the S-42 outranges the S-40 series by a considerable margin, there is no such disparity in dimension and weight as existed between the S-40 and its predecessor, the twin-engined S-41. The span of the S-42 is 114 ft 2 in and the gross weight on which the stress analysis of the new ship was based (38,000 lb) exceeds that of the original Clipper by about 4,000 lb. Horsepower has been boosted from 2,300 to 2,700. The weight empty, however, is some 2,000 lb less than the S-40 (as a flying boat), indicating a great gain in structural efficiency and consequent improvement in payload. The clue to the better performance lies not only in the added horsepower and the obvious areodynamic improvements, but also in the smaller total wing area (S-40—1,740 sq ft, S-42—1,330 sq ft) and the consequently higher wing loading. Designer Igor Sikorsky has expressed the opinion that safety and comfort follow from relatively high ratios of weight to wing area. High loadings mean high landing speed, to be sure, but higher speeds also mean better control during landing. From a standpoint of safety, present landing speed requirements may have been considerably overrated.



Key: (1) anchor winch; (2) co-pilot; (3) pilot; (4) radio operator; (5) flight mechanic; (6) 35 cu ft baggage and mail pit; (7) forward companionway; (8) parts storage locker and storage battery boxes; (9) 22 cu ft baggage space; (10) after companionway; (11) steward's post and equipment; (12) 60 cu ft baggage and mail compartment (two life rafts stowed under hatch)

Although actual performance data are not available at the time of this writing, it is safe to predict that the specifications laid down by Pan-American Airways will be met by the S-42. With a crew of five (two pilots, radio operator, mechanic and steward), a full complement of 32 passengers and baggage plus 1,000 lb of mail and express and a full gasoline supply (1,200 gal) the ship is expected to cruise at 150 m.p.h. for a range of some 1,200 miles. With extra tankage and without passengers, but with a considerable payload in mail and freight, a non-stop range of 2,500 miles can be counted upon, making long trans-Atlantic jumps quite feasible with a comfortable margin to spare.

No more booms

As pointed out in our preliminary discussion (AVIATION, March 1934, page 96) the S-42 differs from other Sikorsky designs in that the tail surfaces are carried directly by the hull and not on open booms. This feature necessitated considerable revamping of control surfaces and their connections and also made for a somewhat longer hull and more spacious cabin accommodations.

On going aboard the S-42 through the after hatchway, its yacht-like proportions are strikingly in evidence. A short Jacob's ladder brings one over the side and onto broad rubber-covered walkways (formed by the open hatch covers laid back onto the deck). A substantial handrail (unshipped in flight, of course) leads down a solid stairway of the companionway into the cabin. A center aisle gives access to all passenger compartments and to the cockpit forward. Bulkhead doors are all watertight, making it possible to seal off any desired hull section in case of damage to the plating. Passenger seats are adjustable and are hung from the bulkheads without legs to the floor. Two completely equipped toilets and washrooms open off the aisle adjacent to the companionway. Steward's equipment, life rafts, auxiliary fire-fighting equipment and a combination mail and baggage compartment occupy the space in the hull between the hatch and the tail.

Passenger cabins

Walls and ceiling in passenger compartments are lined with walnut-balsa wood veneer panels, all removable for inspection of underlying structure. Pads of rubberized horse-hair between the liner panels and the bulkhead panels dampen out vibration and assist in the sound insulation. Three circular windows are provided in each side of each compartment, all fitted with shatter-proof glass and non-openable. Ventilation comes from two overhead ducts with four adjustable registers in each cabin section. Fresh air is taken through a screened opening in the nose of the "tower" connecting hull and wing and delivered through a labyrinth type water separator to the ducts at a maximum rate of 42 cu.ft. of air per passenger per minute. Since the boats are intended for tropical operation, no heating systems have been installed. Control cables pass through the cabin in conduits alongside the air ducts. They may be opened quickly and easily for inspection. Floor panels are also removable in small units to give access to the hull framing. The cross-frames under the floor between the bulkheads have been spaced far enough apart so that a man may go down into the bottom without difficulty, and stringers are arranged so that no water pockets can form between bulkheads.

Pilot's compartment

The chief pilot is on the left and co-pilot on the right in the usual manner. The radio operator and his apparatus occupy the space behind the co-pilot and the flight mechanic is stationed behind the pilot. An interesting sub-division of functions and of instruments has been worked out. Only the essential navigating and engine control instruments (tachometers and manifold pressure gages) are on the pilot's boards. The multiplicity of smaller engine indicating instruments (such as pressure and temperature gages, fuel gages, etc.) are mounted on the rear cockpit bulkhead at the mechanic's post. The pilot in flight is thus concerned only with flying instruments and the mechanic has the responsibility for the correct operating conditions for all four engines. The net result is a great simplification in instrument installations and a considerable contrast to the maze of dials and indicators that usually face the pilot and co-pilot on multi-engined airplanes. The throttle, flap and adjustable pitch controls, ignition switches, master switches, and the fire extinguisher controls are suspended from the cockpit roof overhead within easy reach of both pilots. The selective throttle arrangement worked out for the S-40 has also been applied to the S-42 in somewhat improved form. A door in the forward cockpit bulkhead gives access to the anchor winch and to a hatchway in the forward deck. Just aft of the cockpit a companionway leads to the outside of the hull on the port side. Removable panels in the wall of the passageway give immediate access to the back of the mechanic's instrument board. On the other side of the passage sliding drawers are provided for two 12 volt storage batteries. Each is charged by a separate generator.

Structural features

The hull is of all-metal construction. Outstanding feature is the use of flush type riveting which gives perfectly smooth surfaces outside. All seams are sealed with marine glue and set in fabric during assembly. Wing floats are of the same general type of construction as the main hull, being made up of dural framing covered with dural sheets

The monoplane wing of the S-42 is made up in one piece The center section which carries the four engines is strut-braced to the hull and is rectangular in plan It carries a balanced landing flap along the full length of the trailing edge The flap can be set in various predetermined positions for take off cruising and landing, and is provided with an ingenious automatic control which sets it automatically depending on the air speed of the ship

The wing tip sections are strongly tapered with ailerons running practically the entire length Aileron control is of the cable and pulley type—the cable from each aileron running towards the center of the wing and attached to a yoke for differential action Cables from the yoke run to the control mechanism in the cockpit down through the supporting tower

Tail surfaces follow standard Sikorsky practice, having rudders and fins of a special airfoil section to correct for unbalanced forces due to stoppage of one or more engines All surfaces are metal framed covered with fabric. Rudders and elevators are balanced Stabilizer adjustment is obtained through a conventional thread and nut mechanism operated from large hand wheels in the cockpit. Control surfaces are all hung on self aligning ball bearings and are all equipped with adjustable tabs for minor adjustment. Tabs are adjustable from the ground only.

Power plant installation

The four Pratt & Whitney Hornet R 1690, S3D1-G engines (geared 3 2 rated 675 hp at 5000 ft at 2,150 r p m) are mounted on welded steel tube supports cantilevered out from the front spar Each nacelle structure is fully streamlined and the engines faired by full N A C A cowlings which are quickly removable for maintenance. Three-bladed controllable pitch Hamilton Standard propellers are fitted. All pitch control mechanisms are synchronized from the cockpit Fuel is carried in eight elliptical shaped tanks in the wings between the spars Two tanks feed each engine. Oil is carried in a smaller tank between each two main tanks The outboard engine tanks are provided with quick-acting dump valves The filling of the tanks is manifolded so that gas may be pumped in at one point in the center section of the wing for all eight tanks Oil-coolers with the necessary air control valves are mounted under each nacelle in the bottom surface of the wing.

The new S-42 exhibits an extraordinary number of interesting and ingenious structural details which space limitation prohibits full discussion It is hoped that in later issues of AVIATION we will be able to illustrate and describe many of these outstanding features

Above: The tail surfaces are supported by the cone of the hull The longitudinal trim of the entire hull pivots about the front stabilizer spar fitting Note hand-rail above main entrance hatch, unshipped in flight Left: The hull under construction The wing beams rest on the central tower structure Note forward and rear companionway openings also forward deck and anchor hatches The entire hull is flush riveted so all surfaces are perfectly smooth.

Close-up of the anchor hatch The water-tight cover is operated from inside A geared winch is provided to raise and lower the bronze anchor.

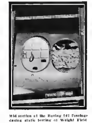
Wright Field completes flight and static tests on the Boeing 247

Load Test—Full Scale

ALTHOUGH the value of test work on models is beyond all question, it is one thing to test a series of paper tubes to determine the behaviour of a monocoque structure, and quite another to take a transport plane out of active service and test it to destruction Seldom does a laboratory get such an opportunity as was afforded by the assignment of one of the Boeing 247 airplanes to Wright Field for complete flight and static test Although the outcome of the tests has been previously reported (AVIATION, March, 1933, page 95) certain details of the procedure and results are of sufficient interest to warrant further discussion

Strength tests on the Boeing 247 were of particular interest since the plane represented a distinct departure from previously accepted types of construction and marked the beginning of the present trend to metal monocoque low-wing monoplanes. One of the most important factors in the investigation was to determine whether or not that type of construction would permit of greater loads and faster schedules than the planes had previously been licensed to undertake. The fact that under static test the fuselage of the plane withstood loads up to 52 tons where a maximum of only 30 tons was required was an indication of the essential soundness of the design. Significant also is the fact that the plane submitted for test was not taken from current factory production, but was withdrawn from active scheduled flying after some 1 400 hours of passenger carrying Tests were made on the basis of a gross load of 13 650 lb some 550 lb greater than the present licensed gross weight In view of the results, application has been made for an increase in the permissible gross load up to 13 650 lb

Before being put into the laboratory the airplane was flown under a wide variety of conditions by a number of pilots and its behaviour carefully watched and recorded It was flown in smooth and rough air, at all speeds between stalling and above 180 m p h with the wheels up and between stalling and level high speed flights with wheels down No unusual vibration developed at any speed when flying with two engines When flying with one engine with the trimming tab on the rudder in an extreme position, a slow vibration of the control surface was observed by looking back at the rudder from the cockpit but was not noticeable on the rudder pedal This vibration did not show any tendency to build up and stopped as soon as two-engine flight was resumed



Mid-section of the Boeing 247 fuselage during static testing at Wright Field Load was not only applied at the stabilizer attachment fittings at the extreme tail, but the rear baggage compartment was filled with shot bags as shown At later stages before final failure occurred this compartment was not only filled, but extra weight piled on the roof above it Load factor in this section at final failure was 8 3

Although flight tests were interpreted in the light of Air Corps requirements for stability and maneuverability, no outstanding faults were reported Elevator and rudder loads were considered a little "heavy" under certain conditions but were easily corrected through the use of the trimming tabs As far as stability was concerned it was recorded that once the plane has been balanced for any particular condition of power or load by the use of the tabs, it could be flown "hands off" satisfactorily

After flight testing was completed the ship was moved to the laboratory where it first ran the gamut of the standard Air Corps vibration tests The natural frequencies of all parts of an airplane structure may be determined by applying vibrations of known amplitude and frequency by mechanical means (see AVIATION, January, 1934, page 21) All possible methods of vibrating wings, fuselage, tail surfaces were applied and the frequency of the controlled tab systems was determined The only portion of the structure which fell outside the limits imposed by the Air Corps, were the engine mounts where the natural period was felt to be a little too close to the normal rate of vibration of the engine at cruising speed to be entirely satisfactory Such a condition is, however, correctable by changing the rubber mounting bushings Particular attention was made to the vibration period of the rear sections of the fuselage, but when all tail surfaces were in place and other accessories mounted, no abnormal conditions developed over the range of loading studied

With the vibration explorations out of the way, the fuselage was loaded with tons of lead shot and pig lead until failure occurred Differentiation was made between that portion of the fuselage forward of the center of gravity and aft of the center of gravity For the entire fuselage the load factors developed under tests were far and away in excess of those required by the Department of Commerce Careful check was made on deflections during the applications of loads. For load factors up to and including 8 0 ahead of the C G and 7 75 aft of the C G the deflections as measured were not excessive At loads equivalent to factors of 8 25 and 8 0, the rear portion of the structure began to settle rapidly, indicating that the elastic limit had been reached Primary failure occurred in the bottom of the mid-section of the fuselage approximately 1 ft behind the rear wing spar All longitudinal members and the skin at that point buckled under compressive stresses At the point of failure the overload forward of the C G was 59 per cent and aft of the C G 62 per cent To complete the story, after failure had occurred samples of the material were removed from various portions of the hull structure and tested both for chemical composition and physical properties In all cases the materials were found to fall within the specifications written for 17-S alloy No evidence of corrosion or fatigue developed

Wing and landing gear tests were not conducted at Dayton as they had previously been made at the Boeing factory at Seattle Wing loads were run up to a total of better than 36 tons the required factors (L A A , H A A., and Inverted) all exceeding the Department of Commerce requirments by a considerable margin. Landing gear tests indicated that the plane could withstand an emergency impact of some 32 tons

In this, the second of two articles devoted to the conclusions reached in the cruising studies made in the course of testing the new Douglas Transport, the authors have defined cruising conditions and conclude their introductory remarks regarding methods of cruising control. Future articles will outline the conventional testing procedure and present a new method of accurately determining cruising performance and controlling cruising operation. Since the first of these articles appeared the transcontinental record breaking flight and many intercity records of the Douglas Transport have served as excellent testimonials to these methods.

Cruising Control in Transport Operation

By Edmund T. Allen and W. Bailey Oswald

THE SECOND OF TWO ARTICLES

COMMERCIAL air transport operators have usually set up their own limitations for cruising. Those having a long background of equipment-maintenance problems determine their limitations at a point where the demand for increased speed meets the demands for decreased maintenance costs and increased reliability of performance. If the airline has little or no competition, is not pushed by the government post office to decrease mail transit time, and sees little gain from passenger revenues by increasing speed, the cruising conditions will be set so as to favor long life of equipment and slow schedules. An example of this kind is the National Parks airways whose operating point-to-point speed has been very slow but whose engine failures for this period have been virtually *nil*. The airline which, on the other hand, is competing stiffly on a speed basis with other lines such as the Varney Speed Lanes, will set its limitations so as to favor high cruising speed and necessarily greater maintenance costs.

In either case, whether set up for high cruising speed schedules or for slow ones, the cruising limitations determined upon by the transport line are influenced principally by the guarantees of the engine manufacturer. Some of the transport lines with a wealth of cost statistics can tell immediately what their increase in mechanical failures and maintenance costs will be for a given increase in cruising r.p.m. With all these data, however, they still do not know what their power output is, for they as yet have no power-control guides. Their data cover only maximum engine revolutions for average altitudes. The supposition is that the failures and excessive wear occurred on those airplanes which exceeded the maximum cruising r.p.m. But there has been no method for bringing up the slow ones who drag down the schedule to, but not past, the limit.

Limitations on maneuvers

The airplane manufacturer's limitations upon the abuse of his product include a diving speed limit, a pull-out acceleration limit, a landing abuse limitation, and sometimes a taxiing speed limit on rough fields. Sometimes the airplane is built for high-speed diving, and more recently these diving limits have occasionally been removed so that long vertical dives up to terminal velocity have been considered, while not "normal," in the class of cruising, still "emergency," in the class of single engine overload emergencies. Pull-outs from dives, even for military aircraft, have never reached the stage of entire removal of limitation, although it seems that this stage has been approached so closely that the stress on the human organism reaches its yield point before the stress on the material of the structure. To build the airplane which cannot be broken up in the air by the most violent actions of a pilot bent on destroying himself or else gone completely out of his senses, has been an ideal of some aircraft people, but the penalty to be paid for such a structure has restrained them. Neither a performance penalty for an excessively heavy airplane nor a control penalty, where the stability and power of the controls are such that they resist the most powerful effort at self destruction, are attractive.

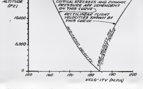


Fig. 1. Variation of true and corresponding indicated velocity with altitude for constant power. Stresses and dynamic forces acting on an airplane are proportional to dynamic pressure and hence to indicated airspeed

As airplanes become more and more efficient, and tend more and more also toward careful control of structural weight, the diving and acceleration limitations on commercial transport types approach those used in normal flight. Thus for a modern transport airplane which can cruise at 200 miles per hour, it might well be considered abuse of the structure to subject it to indicated airspeeds 25 per cent above this cruising speed. It is quite probable that in the near future cruising speeds may be realized on airplanes which cannot be flown safely at indicated airspeeds as high as their realized cruising speeds. This seeming paradox will be dwelt upon more at length later. It can be appreciated more readily when it is remembered that stresses and dynamic forces on an airplane are proportional to dynamic pressure and hence to indicated airspeed, while cruising speeds at constant power increase with altitude although indicated airspeeds are decreasing. This relationship is illustrated in the graph of Fig. 1.

The airplane is designed for certain stresses normally realized in normal flight. The load factors multiplied by these stresses determine the ultimate strength which is approached only in the worst possible maneuver or air load the airplane will ever be called upon to withstand. The accelerometer, when mounted at the center of gravity, records the applied accelerations of air bumps or pull-outs in units directly convertible to load factors. The airplane manufacturer thus has a ready means for determining the limits which he places upon the airplane operation in terms the pilot can apply directly to his flight. This is illustrated in Fig. 2.

The airplane manufacturer, then, defines cruising and emergency operation for his product in terms of his specifications or guarantees. Cruising is normal operation at usual operating speeds. These speeds are those corresponding to 75 per cent power in most instances. He is naturally interested in operating the engine in his airplane at the maximum permissible cruising power for which the engine builder will guarantee it. For in this condition he will obtain the optimum possible airplane performance and therefore the best sale value. He regards as emergency operation such overloads as diving, pullouts, full-power flight.

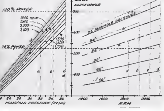


Fig. 3. Variation of manifold pressure and engine revolutions with brake horsepower showing areas for cruising, climbing, takeoff and emergency operations. Although these curves are for sea level operation, all limits hold for any altitudes for which they can be obtained. Operation regions are shown below and to left of lines labeled as follows: (a) Cruising 32" M.P., 1,850 r.p.m.; (b) Climbing 34.5" M.P., 1,950 r.p.m.; (c) Takeoff 36.8" M.P., 2,050 r.p.m.; (d) Emergency 36.8" M.P., 2,100 r.p.m.

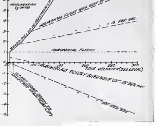


Fig. 2. Acceleration versus velocity for sharp pull-up to maximum lift for horizontal flight with 15 ft. and 30 ft. per sec. up gusts and the down gusts. Cruising level flight, rather than the sharp pull up, is rapidly becoming the critical design case

Data from the engine builder

The last and most specific definitions and limitations for cruising conditions come from the engine builder, whose data on engine stresses in relation to power are more detailed and rich in material for defining cruising limitations than those of any of the other agency. For our power determination we must go to the engine manufacturer whose thousands of hours of testing under carefully controlled conditions serve as the principal guide to the transport lines, the military services, and private flying. By operating engines at excessive overload until they break down he can determine which parts need attention in the recurrent process of pushing up power output. He has repeated this process under all possible combinations of conditions to be met in service from the excessively high r.p.m.'s of a terminal velocity dive to the excessively high supercharging in an emergency takeoff. He has operated engines at rated power for long periods with excessively hot oil to determine effect on wear and tear. He has statistics on thousands of hours of cruising operation under all sorts of conditions together with records of wear, replacement requirements, cost of operation, and general engine functioning. He knows the effect of a few seconds of overload (for takeoff from a bad field), of many minutes of high cruising load (for climbing up to cruising altitudes), and of the hour-after-hour pounding of lower power cruising. Knowing this he is in the key position to specify how the engine shall be operated to give maximum life and minimum costs for maximum cruising power output.

The engine builder is very positive and definite in his statement of operating limits for each part of the transport flight. He specifies the exact limitation for engine revolutions, for Mean Effective Pressure, for cylinder temperatures and for oil temperatures. That these limits are quite different for the operations of cruising, of climb, of takeoff, and of emergency is to be expected from his determination that engine reliability and wear are functions of time of operation under certain stresses, as well as of the quantitative value of the stresses. These values are given in the following table for two recent engines of approximately 700 hp. each. The differences in the values between the two engines are of no concern to us here. The SDG is a higher speed engine than the F3 but of lower displacement and slightly (1.4 per cent) lower power.

Power is roughly proportional to the first power of the r.p.m. and to the first power of the Mean Effective Pressure. Intake manifold pressure determines Mean Effective Pressure, and it is thus just as large a factor in power output as engine revolutions. It largely determines cylinder and piston wear and bearing loads. Its limitation is considered quite as important by the engine builder, if not more so, than the engine revolution limitation. The relationship of manifold pressure and engine revolutions can be best illustrated in Fig. 3 which shows on one side, manifold pressure *vs.* power for various engine revolutions and on the other side, engine revolutions *vs.* power for various manifold pressures. Full rated power has been indicated by the top horizontal line, and 75 per cent power by the heavy dashed line. It is quite clear from this chart that one may have one's power at whatever proportion of engine revolutions and manifold pressure one wishes. The limiting revolutions for each operation and the limiting pressure for each operation are shown on the graph by the heavy lines labelled accordingly. Thus the area under each set of heavy lines is the available area for the operation in question.

Engine Manufacturer's Limitations for Pratt & Whitney Hornet SDG

	r.p.m.	Manifold Pressure	Max Cyl Temp.	Max Oil Temp
Cruising	1950	32.0	400	160
Climb	2050	34.5	475	180
Takeoff	2150	35.5	475	200
Emergency	2260	35.5	475	200

Engine Manufacturer's Limitations for Wright Cyclone F3

	r.p.m.	Manifold Pressure	Max Cyl Temp.	Max. Oil Temp
Cruising	1850	32.0	475	160
Climb	1950	34.5	500	180
Takeoff	2050	36.8	560	200
Emergency	2150	36.8	580	200

The most noteworthy point to be gleaned from a study of these tables and figures is that cruising operation, for instance, up to the manufacturer's limit for cruising engine revolutions causes no greater wear nor unreliability at constant power than cruising operation up to the manufacturer's limit for cruising manifold pressure. Our habits of looking at power purely from the engine revolution standpoint lead us to look askance at what seems to us high cruising engine revolutions while accepting easily dangerously high manifold pressures. There is no more justification for the transport line to object to cruising at 1,950 r.p.m. if 75 per cent power is needed than for his failing to object to cruising at 32 in. of mercury intake manifold pressure. It is evident that the engine manufacturer regards the engine revolution limitation as of less consequence for emergency than the manifold pressure limitation since the latter is not permitted to exceed climbing manifold pressure even for the worst emergencies while the revolutions are calmly allowed another hundred or so. This significant fact is seen in the case of both engine builders mentioned above. The engine builders point to the fact that for constant 75 per cent power, the operation at 1,960 r.p.m. relieves some of the bearing loads induced by explosion pressures and is easier on the engine than would be a 75 per cent power cruising with propeller pitch set up to limit the r.p.m. to 1,800 with consequent manifold pressure for this power of some 34.5 in. at critical altitude. On the airplanes which demonstrate terminal velocity diving, the engine revolutions during the dive are allowed to go up as high as 3,100 r.p.m. but intake manifold pressure is strictly limited by requiring that the throttle be closed during the dive. A 25 per cent increase over normal manifold pressures would be much harder on the engine than a similar increase in revolutions. This point is still not fully appreciated by many transport operators.

Controlled cruising is not simply a power limitation, much less is it an engine-revolution limitation. It must be an answer to the whole aero-structural, aero-economy riddle. Improved cruising technique will get more people into the air, take them quickly, safely, comfortably, economically to their destinations.

This article has presented an outline of present methods of cruising control with a definition and delimitation of cruising conditions. It has attempted to show that present conceptions of cruising are inadequate to meet present demands of operation. The writers plan additional articles [in early issues of AVIATION] in which they will outline the conventional testing procedure for determining cruising performance and present a new method of accurately determining cruising performance and accurately controlling cruising operation.

Sodium Beacon

DUTCH illuminating engineers have perfected a new type of lighting unit for airway beacon service, which has shown unusually good fog penetrating qualities. The Philips sodium beacon has been in successful use at the Walhaven Airport at Rotterdam.

A 1,500-watt unit, which emits 9,000 candlepower, consists of four glass vacuum flask castings, each 30 in. long, containing neon-filled inner tubes. A certain amount of metallic sodium has also been introduced into each Neon tube. When the tubes are cold the sodium is deposited in metallic form on the inner surfaces, but as the units warm up the sodium vaporizes and emits its characteristic yellow light. On the basis of lumens emitted per power unit input, these lights are approximately ten times more efficient than the average incandescent type.

No reflectors of any sort are used. The tubes, in a suitable framework, are simply mounted on a metal tripod.

EDITORIALS

AVIATION

EDWARD P WARNER, *Editor*

Notes on a Great Confusion

THREE MONTHS AGO the average citizen of the United States thought about aviation but little or not at all. He used the air mail occasionally, and knew that when he used it his letters went through promptly to their destination. He might occasionally travel on the airlines, or if he failed to use them himself he had plenty of friends who did so, and he knew in a general way that it was possible to go from practically anywhere to practically anywhere else at a very high rate of speed and at a fare not much exceeding that of the railroads, and that accidents were rare enough so that there seemed to be no occasion to worry about them. He had seen news reels of the Air Corps performing military evolutions and of naval aircraft maneuvering from the aircraft carriers, and he had marveled at the skill displayed and at the perfection of the organization. But he never got very much excited about such matters. It seemed to him perfectly obvious that aviation was making tremendously rapid progress, and that appeared a sufficient evidence that it was in the hands of people who knew how to do the job. It seemed plain on the face of the matter that things were going remarkably well, and he was quite content to let it go at that.

But that was last December or thereabouts, and this is March. The same gentleman now seizes eagerly upon his morning newspaper and looks to the top of page 1 to see what new scandals have been alleged, what new recriminations have been exchanged, and what new crashes have occurred. On the editorial page of the paper he finds at least once a week, and in some cases nearly every day, a vehement assault either upon the character and the integrity and the competence of the aircraft industry or upon the wisdom of the Administration's action in aeronautical matters and upon the motives of its advisers. Everyone has taken sides. Every newspaper, and very nearly every newspaper reader, has enrolled himself in one camp or another, and no charge is too sensational to be made and to be believed. Aviation has become the leading political issue of the day, and our friend the average citizen, still more or less keenly aware that he knows nothing in particular about the subject, is nevertheless filling himself up with a choice collection of prejudices and antagonisms, not to mention some very remarkable delusions on matters of simple fact. Public opinion is enveloped in a fog of unprecedented density. The typical American has an agitated conviction that something ought to be done immediately, but he has no concrete idea what it should be. Neither, it may be said in passing, have a good many of the people upon whom some part of the responsibility for determining decisions on policy must ultimately rest.

From a multiplicity of counsellors competitively clamoring, cometh little wisdom. The discussions of the last six weeks have produced a deal more heat than light. Recognizing that sad fact, every reader of AVIATION has a new responsibility. We are supposed to be the experts in the field, and it is up to us to enlighten our neighbors. There probably is not a single subscriber to this magazine, unless he lives alone in the middle of a vast wilderness, that hasn't been confronted over and over again with demands for "the lowdown on this air-mail stuff." The temptation is no doubt strong to respond to any such invitation with objurgation and invective, but the temptation must be resisted. Patiently, calmly, conservatively, specifically, we must explain the facts. The case of American aviation is far too strong to be dissipated in mere indignation. Each of us, and that goes for every reader of this paper, must become a personal center of reliable information, and we *must* preserve our confidence that somehow, ultimately, the truth will prevail.

Most apparent current fact is that an emergency has been created, not only in air transport but in military aviation as well. There is an urgent demand for action, and if action designed to be the foundation of a permanent policy is rushed into in an emergency spirit the odds are heavy that it will prove to have been foolish.

With so much all going on at once, it is impossible to get any sense of continuity except by focusing attention first on one ring of the circus and then on another. Ultimately air policy must be considered as a whole and its parts must be brought into some rational relationship to each other, but as a preliminary we ought to look at each part by itself and to see what good sense and a reasonable interpretation of experience allow in connection with each one.

I.

Air Transport

THE MAIN ACT in the air transport ring just at present is the legislative preparation for revising the air mail system We discuss that elsewhere in the current issue in full detail, so we may confine ourselves here to more general observations The bill most under discussion at the moment has certain inconsistencies and a number of bad and unjust and positively unworkable features, but the attitude of the committees that have been holding the hearings gives every reason to expect that substantial improvements will be made before the measure is finally passed and becomes law

There is the sharpest division of opinion, and the sharpest fight is likely to be centered, upon the status of the existing companies, holders of the cancelled contracts Quite apart from any consideration of justice, they are threatened with becoming the victims of a political struggle in which certain of the adherents of the Administration are implacably resolved that the companies or at least their major officials must be permanently disbarred from any share in air transport operations, and that the disbarment must be accomplished without any resort to court proceedings as a justification of the summary action already taken

We refuse to believe that any such attitude is at all general We earnestly hope that the transport operators will maintain themselves firmly and unanimously upon the ground of the right of every man, even the least of their employees, to have a trial in accordance with due process of law before being subjected to any penalty, and in particular before being forbidden to practice his chosen vocation We have no sympathy with anyone who may be definitely proved guilty of any improper act, but we still insist that justice demands that the proof be presented before an impartial tribunal Executive condemnations have no place in American justice.

Compared with the great issue of the right of trial anything else seems trivial, but there are other matters that deserve mention Foremost among them is the necessity perhaps not even yet sufficiently emphasized, of experienced personnel for an air transport line Not only must there be a few experienced pilots, but the organization must be experienced as an organization It is not too much to ask that any group that applies for an air mail contract should be required to show that they have actually been engaged in operating some kind of an airline for a reasonable period and with satisfactory efficiency The potential effects of a provision that would allow anyone who could raise the money for a bond to put in a bid, and then give him six months to get together an organization and decide how they were going to operate after the contract had been awarded, would be simply dreadful. Equally dreadful would be the results of a subdivision of each of the transcontinental routes into a number of short stretches, independently allotted to different contractors and independently operated yet it appears that such a scheme has actually been seriously considered

To offset all these alarms at least one very bright spot is visible. There is at least one piece of good news, and that is that practically all hands seem to be agreed that the allocation of air mail payments and the financial relationship between the transport operators and the government ought as soon as possible be taken out of the hands of the Post Office Department and put into those of a non-political commission The readers of AVIATION will remember that we have supported that theory for a long time past and it is with profound relief, in the midst of all the present turmoil, that we see the commission idea apparently on the point of gaining general acceptance

II.

The Army Flies the Mail

THE ARMY AIR CORPS has suffered severely through the air mail cancellation It has lost four men actually flying the mail, and seven more in preliminary practice and in ferrying ships and the like It has had about half a million dollars' worth of equipment washed out Finally, and by no means least serious, it has been the victim of an utterly undeserved loss of public confidence The accidents that have attended on attempts to take over the mail routes have been heralded as showing the total unfitness of our military aviation, the inferiority of its equipment and its personnel, and the unsoundness of its organization All that is practically chemically pure nonsense, and it deserves to be shown up as such

To abbreviate a story which could be told at enormous length if space permitted, there were several basic troubles in the way of the Air Corps being able to carry the mail successfully They were plain from the first to anyone who knew how commercial aviation was operated and also knew something about the military services, and there were plenty of people in the aeronautical field who made grimly accurate prophecies of what was going to happen as soon as they heard of the issue of the order to the Army

Foremost of the Army's afflictions was the failure to realize the extent to which successful commercial operation in bad weather depends upon the pilot's specialized knowledge of the route that he flies When the time comes for getting into an emergency field at night and in a snow squall the pilot to get away with it successfully will be the pilot that has circled the field repeatedly, that has studied its every obstruction, and that has made practice landings in it by day under all manner of wind conditions The newcomer on the route, with only the boundary lights and obstruction lights to serve as his guide, is going to crack up under conditions that would never cause a moment's worry to the man to whom flying that particular route has been a profession

and the study of the route a constant preoccupation for months or years To the Air Corps officer however great his skill as a pilot and as a navigator may be, the little group of lights showing up through a rift in the clouds on the route that he first undertook to fly a couple of weeks ago is just a group of lights. To the old timer on a commercial line the same group spells Allentown or Fort Wayne or Ponca City as plainly as though the name had been picked out in letters of fire

The second great difference between the Air Corps and the commercial operations, and the second great handicap to the Air Corps in attempting to do a transport job, has been the difference in intensity of the typical pilot's flying experience The average Air Corps pilot gets 200 hours of flying a year, and the officer that gets more than 400 is a rare bird indeed The first pilot on an airline puts in somewhere between 800 and 1,000, and he does it year after year, with no interspersed tours of departmental duty behind a desk to cut his flying time to a hundred hours a year or less Limitations on appropriations and the watchfulness of the Budget Bureau over any apparent extravagance with aircraft gasoline play a big part in the difference, but economy is not by any means the whole story A more serious factor is that whereas the Air Corps has to be ready for war tomorrow, it also has to be ready for war five years from now If war were absolutely sure to come within the next 60 days, it would be possible to concentrate on training lieutenants in the Air Corps to be good number 3 men in fighting formations to the total exclusion of every other element of their education But if that were to be our course, and if war were to disappoint us by failing to arrive on schedule, we would have a lot of superlatively skilled junior officers who had been doing nothing whatever to prepare themselves for the higher commands into which they would naturally in due course be promoted

The pre-eminent and in fact the only professional obligation of the airline pilot is to carry loads of passengers and mail smoothly, safely, uneventfully from place to place on regularly scheduled flights Everything that in any degree contributes to his ability to do that job, he must study, everything outside its bounds is more or less redundant from a narrowly professional point of view The officer of the Army Air Corps has no such specifically limited list of duties First of all he has to fly, but beyond flying he has to do a wealth of paper work—he has to assume occasional administrative offices that leave but little time for flying even if unlimited airplanes and unlimited gasoline were available—he has to go from time to time to a variety of specialized schools for training in the art of war,—he has to serve very often as supply officer or engineering officer of a squadron,—and at a very early stage of his career he begins to have men under his command and to have to take responsibility for their welfare and their training The airline pilot, in short even though in some cases he will ultimately become an executive of a line functions for the time being purely as a professional pilot able to concentrate entirely upon piloting The junior officer in the Air Corps, on the other hand, has to be considered not only as the second lieutenant of today but also as the major of the years to come, and he has not only to be trained for his present job as a minor unit in a squadron but prepared also for the day when he will command a group That problem exists in every military service in the world, and not even an increase of appropriations will change it The officers of the army can't be made genuinely efficient in doing the jobs of the commercial airlines without at the same time losing ground in their ability to perform their own functions, of which actual personal flying is only a part, in many cases a minor one

Equipment has of course played a part, and it is therefor the first time that we encounter reason for real concern and serious inquiry Plainly the Army plane is handicapped as against the specialized transport type Added weight costs too much in fighting ceiling, and the space left for instruments and the like after the necessary military equipment has been installed is limited Nevertheless, making allowance for all those factors, it still seems that the record of the Army's navigational equipment, and most especially of radio, was disappointing if not deplorable The report of non functioning radio was disconcertingly frequent in connection with forced landings, and service personnel ought to focus attention there for what may be some very salutary lessons Navigating equipment was not the major cause of the Army's troubles, but it was a contributory one, and it is distinguished from the other causes in that it should seemingly be subject to some rectification without sacrifice of military considerations

Finally there is airplane design Of that much might be said, but one point is at once typical and transcendently important The old government-operated air mail service hadn't been running the mail for two years, immediately after the War, before it had learned the necessity of putting the mail in a pit between the wings and getting the pilot well back toward the tail for safety in a crash The same arrangement still persists in practically all of the planes now used for mail flights when the weather is too bad to risk going out with passengers The Army on the other hand necessarily fixes the pilot's location from military considerations and puts the mail where the observer would be with the result that the pilot is in the most hazardous position possible and that a variation in mail load unless fully compensated for by ballast, has an immediate and in some cases a really serious effect upon the longitudinal stability of the airplane

Under all those handicaps and others of lesser order, the wonder was not that the Army had accidents, nor that it failed to equal the privately-operated service in efficiency but rather that the accidents were no more numerous and that the operating record was as good as it was

III.

Military Aircraft Procurement

THE PROCUREMENT PROBLEM can be summed up in one single warning declaration If the War or Navy Department should decide, or if Congress should take steps to enforce, purchase by issuing general type specifications and inviting competitive bids the inevitable effect will be to lower the efficiency of our air services and to involve our air force equipment policy in just about as complicated and disastrous a jam as the flying of the air mail got into in the closing days of February Experience at home and abroad as well as the application of plain common sense in the light of a knowledge of the way in which airplanes are designed and built, all agree in proclaiming disaster along that line If either the Congress or the Assistant Secretary of War set out to make a fetish of competitive bidding on military airplanes, they will be playing with plenty dynamite,—a fact which will become only too apparent in due course

Less certainly disastrous is the scheme of putting a substantial part of the construction of service aircraft into government-owned plants, but of that move, too, the effects are almost certain to be bad It is of course perfectly possible for the Army and Navy to recruit a specialized force of aeronautical engineers who will make a professional specialty out of aircraft design and take the sole responsibility for the initiation of military and naval aircraft projects, exactly as the corps of naval constructors now controls the design of all warships That doesn't seem to us the best way of getting new and useful ideas into military airplanes, but it is at least a possible scheme

To mingle government design and construction with design and construction by private firms, however, threatens a sacrifice of the virtues that either system by itself might possess The service personnel will be involved in a limited amount of design and production They will in the inevitable nature of things be developing ideas and enthusiasms of their own which they will want to push, and they will find themselves in the position of being at the same time competitors in a contest and the judges of its results It is extremely difficult for the best of men to preserve a judicial attitude under those conditions The most sagacious and the most successful of private constructors is then likely to be the one who sticks very closely to the doctrine that the service personnel have embodied in their own design, and the restriction of private initiative and the inhibition of the free play of imagination in the development of military aircraft designs in the industry are inevitable Those have always been the consequences of government entry into the business of aircraft construction or even into the field of aircraft design on any large scale, whether here or in European states and there is no reason to suppose that the experience of the future will differ materially from that of the past The trend of procurement policy, and especially of the thought of Congress upon procurement matters, seems to be toward the adoption of practices sure to retard progress and to slow down an improvement in military aircraft performance which has been extraordinarily rapid over the past three years

IV.

Building an Air Policy

THERE ARE other rings in the circus and other aspects of an aeronautical program, but for the moment at least they seem less important Some time in the very near future it will become apparent that policy must be considered not only in its several parts but also as a whole That does not mean that all aeronautical activities must be centered under a common head, and indeed any merging of military and commercial aviation would be bad for both and disastrous for the latter, but it does call for a certain consideration of the relations of the aeronautical interests of the various departments of the government to each other and of the ways in which they can best be made to supplement each other without losing their efficiency in their own primary functions To the end of making such a study, the time is more than ripe for the appointment of a Presidential board of distinguished citizens of varied interests and points of view who can consider this as a public service of immeasurable importance and who can plan to give to it at least the major part of their time for a number of months Certainly there is no field in which the value of such an inquiry would be greater

It is more than eight years since there has been a general examination of the air policy of the United States, and during that time aircraft have improved and the nature of aerial operations has changed out of all recognition Now, to escape becoming victims of the wiles of fanatics with a cause to serve or of propagandists with something to sell we should survey the field once more The President cannot possibly take the time to do it himself Neither can executive officials of his Administration, who would in any case find it difficult to command the detachment that a broad survey of the whole scope and prospect of air policy demands Those whose concern is not with the promotion of any particular corporate or individual interest, but with the good of American aviation as a whole and with its continued development of steadily improving service to the American people and steadily increased strength as an arm of their defence, will breathe easily for the first time in many weeks when they hear the announcement of a Presidential determination to appoint a special board to inquire from stem to stern, into American aviation and into the best and most economical ways of promoting its progress along the lines of maximum utility

---

NEWS OF THE MONTH

Mail moratorium

TEN FATALITIES among Army fliers since the command to take over the mail was issued and a mounting tide of public criticism against the advisability of using the Air Corps in a capacity for which they had obviously not been trained, elicited an order from President Roosevelt through Secretary of War Dern on March 10 to "stop carrying of mail except under such conditions as would insure against constant recurrence of fatal accidents"

The following day Maj Gen B D Foulois, Chief of the Air Corps, announced that mail operations would be suspended entirely until a higher safety factor could be established At the same time he reiterated that loss of life is inevitable in the development of military flying, that the emergency had been hailed by him as an ideal peace-time test for the Army, and that furthermore the percentage of mortality had been neither unduly high nor in any way unexpected considering weather and other conditions He then departed on an inspection tour over the mail routes of the Eastern and Central Zones to see to it that the greatest possible caution and efficiency be established throughout the service In carrying out his orders planes and personnel were redistributed, better blind and night-flying instruments were installed, and pursuit planes, which carry only a small mail load were discarded in favor of larger ships New fast Martin bombers, now on order for the Army, will be added to the mail service as soon as delivery is made. Army officers and the Post Office Department together worked out a curtailed schedule of mail routes, selected on the basis of the poundage formerly carried as well as on the basis of safety

Meanwhile another investigation committee swelled the list when Secretary Dern instructed Generals Drum, Foulois, Simonds, Gulick, and Kilbourne of whom Foulois is the only one with actual experience in aviation to look into the matter of Air Corps efficiency in general, and specifically into its mail operations Three of the most highly publicized names in the aeronautical world were added as non military members of the committee but two were struck off again as Clarence Chamberlin was the only one of the trio who felt disposed to accept the honor Orville Wright, pioneer at Kitty Hawk 30 years ago, was obliged to decline because of ill health, Col Charles A Lindbergh refused to serve on the grounds that in his opinion the use of the Air Corps to carry mail was unfair both to Army personnel untrained in commercial flying and to the transport companies whose contracts had been cancelled without hearing Urged to reconsider by Secretary Dern, Colonel Lindbergh telegraphed a second refusal stating that he could not take part 'directly or indirectly in the operation by military forces of American business and commerce"

Grateful for the week's respite from abnormally exigent flying duty, Army personnel enlisted in mail service complained however that they were without funds for food or lodging and were existing as best they might on credit since Congress had not yet passed the Air Mail Bill providing them with the $5 per diem allowance for extra expenses Enacted by the House (AVIATION, March, page 92) the bill was amended by the Senate and returned to the House for approval The President signed it on March 26

Providing additional benefits for Regular and Reserve personnel killed or injured in mail service, one amendment entitles either class of officer, if injured not only to regular disability retirement, but also to Veterans' Bureau compensation based on the war rates for disability. In case of death the dependents of either Regulars or Reserves would receive the customary six months pay gratuity and war time widows compensation of $30 per month instead of the $22 provided in time of peace This amendment was made retroactive in order to apply to the ten dead fliers Another amendment provides that planes should not be commandeered for mail service unless fully equipped for safe day and night mail transport, nor should pilots be assigned to mail duty unless fully trained in the use of such equipment.

Executive headquarters of the Eastern Zone were transferred for the third time (AVIATION, March, page 92) from Floyd Bennett Field in Brooklyn, New York, to the Army's Mitchel Field at Garden City, Long Island, because of inability to reach an understanding of the terms of the day-to-day lease offered by Mayor LaGuardia

Two days before the resumption of service, the eleventh Army fatality occurred. Reserve Officer H G Richardson, formerly co-pilot for United Air Lines, crashed on a test flight near Cheyenne, Wyo

Though airstamped letters were presumably carried by the railroads during the hiatus, it was later divulged that large users of tha air mail system had wriggled out of the situation, highly inconvenient to business houses long accustomed to the swift service furnished by air, by wrapping in a package letters to a common destination and sending them as air express Nothing in the Post Office regulations forbids this practice, provided that the full air mail rate is paid for each letter plus express charges Thus the transport companies disqualified from mail carriage continued to fly letters bunched as express, which resulted in the case of some companies in a rise of 120 per cent in express loads Between New York and Chicago the rate for air express varied between a minimum charge of $1.25 a package to 30 cents a pound in units of more than 20 lb and commensurately on other lines in proportion to the distance covered

One week after the grounding order the Army set out again over eight routes, estimated as about 40 per cent of those established by commercial lines, and about 80 per cent of those first flown by the Army Of this new mail service the Post Office Department washed its hands, beyond advising on technical matters pertaining to rates

Calendar

April 14—Dedication Port Kenyon Flying Field, Kenyon College Gambier Ohio

April—Dedication of Pan American Airways System's International Marine Airport, Dinner Key Fla

April 27-May 6—International Show of Sport & Touring Aviation Geneva, Switzerland

May 27—Deutsch de la Meurthe Cup Race, France.

June 8-10 — Coupe Mondiale d'Acrobatie Aerienne (International Aerobatic Competition), Vincennes, Paris France

June 17-22—Summer Meeting, Society of Automotive Engineers, Lake Saranac, N Y

June 23-July 8—Annual meeting Soaring Society of America Elmira, New York

October—MacRobertson International Air Race London to Australia.

November—Viceroy's Challenge Trophy 700 mile race India and poundage, and transporting mail to and from airports Covering about 7,049 miles, the routes consist of those from Boston to New York, New York to Chicago, Chicago to Dallas, Salt Lake City to San Diego, Salt Lake City to Seattle, Cheyenne to Denver, Chicago to San Francisco New York to Atlanta and Jacksonville Every possible precaution will be taken by Army officers against mishap, including cancellation of flights unless weather is unconditionally good, which includes a 3,000-ft ceiling at all points along the routes to be flown Later the minimum ceiling requirement was lowered to 500 ft for daylight and 1,000 ft for night flights

Reconstruction

A letter from President Roosevelt to House and Senate committee chairmen urging speedy enactment of legislation to return the air mail service to commercial operators as soon as possible, and including specific suggestions for a new air mail policy, sent Congress scurrying to draft permanent air mail bills Rising from the base of Presidential recommendations, a pyramid of proposed legislation hastily and somewhat unsteadily sprung up This massive structure of bills, of which the one known as the Mead-McKellar-Black Bill holds the keystone position because it has the backing of the administration, is fully discussed elsewhere in this issue (see page 99)

As a means of clarifying their ideas in regard to the essential factors necessary for a truly constructive air mail policy, as yet confused in the Congressional mind, the Post Office Committees of both houses summoned to their hearings on the McKellar Bill aviation experts from the darkly suspect aeronautical world These witnesses included Col Charles A Lindbergh, technical advisor to Transcontinental & Western Air and Pan American, Col Clarence Chamberlin transatlantic flier Capt Edward V Rickenbacker, vice president of North American Aviation, Amelia Earhart Brig Gen William Mitchell, W A. Patterson of United Air Lines Carleton Putnam, president of Pacific Seaboard Lines, W A Letson, of United States Airways, J B Brooks Parker, well-known aviation insurance broker, Harlan Hull, representative from the T W A Pilots Association, and Edward P Warner, editor of AVIATION In presenting their ideas as to the best ways of encouraging the development of aviation, the witnesses demonstrated that their views were in complete disagreement with most of the provisions of the bill

On March 28 the chameleon air mail situation again changed color when Postmaster General Farley announced that pending permanent legislation the air mails would be returned to private operators Advertisements for bids were to be sent out at once, calling for submission of bids within fifteen days and requiring successful bidders to start operations within 30 days after receiving contracts To be eligible for bidding, companies whose contracts were cancelled must change their corporate set up and must dismiss all "responsible executives" present at the May, 1930, conference These companies were invited to offer evidence to the Post Office Department that they had met the new requirements, and to advance arguments in defense of their previous actions Contracts will be made for a three month period and the Post Office may extend them for one or two three-month periods The revised schedule contains fifteen routes, covering about half the mileage previously flown by commercial routes

Procurement investigations

Refusing to indict by a vote of fifteen to eight at the close of its investigation of an alleged conspiracy to defraud the government in sales and purchases of motor vehicles and clothing, a District of Columbia grand jury dropped proceedings and handed over a transcript of its hearings to the House Military Affairs Committee By way of approving a more thorough investigation into the well-thrashed question of War Department procurement, the House of Representatives, at the instigation of J J McSwain, chairman of the Military Affairs Committee, voted $10,000 to defray expenses of the inquiry and vested wide authority in the subcommittees appointed to the task The aviation subcommittee, under Representative Rogers of New Hampshire subpoenaed H H Woodring Assistant Secretary of War in Charge of Procurement to testify concerning details of airplane bids sent out since his accession to office last March

Once more facing the charge that he had lowered the specifications for PWA airplanes, which he had previously been asked to explain at hearings before the Appropriations Committee and the House Military Affairs Committee (AVIATION, March, page 93) Mr Woodring again emphatically denied that he had done so, When General Foulois, Chief of the Air Corps, was called before the subcommittee he upheld Mr Woodring's statement, explaining that the change referred to was from negotiated to competitive bidding That of course made a lowering of specifications inevitable if any competition at all were to be obtained

Meanwhile, complete absolution from charges of profiteering was tendered to airplane manufacturers by the House Naval Affairs subcommittee investigating naval aircraft purchases The majority report submitted by the committee's Democratic Chairman John J Delaney of New York placed, moreover, a stamp of unqualified approval of the current method of procurement of navy planes According to the report the profits of manufacturers were moderate and reasonable, since it was shown that the average overall profit on aircraft and engines for the navy from 1926-33 was 11 5 per cent prior to deducting state and federal income taxes, as determined by navy auditors The small average profit on planes was attributed by the committee to the fact that the naval aircraft factory at Philadelphia acted as an effective brake on the price of planes These profits should be considered in connection with the fact that all companies except one have lost money consistently on experimental contracts Far from finding evidence of collusion between contractors or between contractors and naval officials the committee stated "that, on the contary there appears to be keen competition in a limited market, and that furthermore the navy has made commendable progress in its aviation material while keeping the costs well below original estimates and even below actual appropriations The committee described the policy of negotiated purchases pursued by the Navy Department since the adoption of the Aircraft Procurement Act of 1926 as a practical and prudent one efficiently administered which should be followed until the aeronautical industry becomes more stabilized On the other hand, the committee recognized the advantage of applying competitive methods whenever practicable which would insure obtaining the best equipment that the aircraft industry as a whole is able to produce A greater amount of production in the Naval Aircraft factory the committee feels, would stimulate healthy competition, keep a check on what constitutes fair profits, and at the same time would train navy personnel in mechanical operations connected with airplane manufacture as well as in the general details so that navy officials will be as well informed and as competent as the representatives of commercial firms with whom they must deal

Data proporting to show that the navy has continued to buy airplanes through a method alleged to be not strictly legal will form part of the minority report of Representative McFarlane of Texas, dissenting member of the subcommittee Around 75 per cent of navy purchases are reported by the Comptroller General to have been made without competition under provisions of the Procurement Act of 1926 The snag in procurement procedure which Mr McFarlane pounced on is found in the second part of Section K of the act which provides for purchases in quantities of experimental airplanes and engines which have been tested, but fails to specify that they may be purchased by negotiation.

From the conference of Senate and House members over the amended Vinson Navy Bill (AVIATION, March, page 94) it was reported that the Budget Bureau will send a $4,000,000 estimate to Congress for extending the naval aircraft factory at Philadelphia to carry out the provision that not less than 10 per cent of the 1 184 planes authorized in the bill shall be constructed in government plants The conference report, which will come up in the House prior to the amended bill allows the President to build only to the extent thet facilities permit, if he finds that it is impractical to build 10 per cent of the planes The original Senate amendment offered by Senator Bone of Washington proposed that 25 per cent of the planes be built by the government, and the conference agreement reduced it Compromise was likewise effected in the matter of manufacturers' profits now to be restricted to not more than 10 per cent of the face value of the contract,

NEW BEECHCRAFT UNDERGOES TRIAL

Latest design by Walter Beech (see AVIATION January, page 31 for technical details) clocks 175 m p h in flight tests A 225 hp Jacobs engine is installed in plane which is the first Beechcraft to have a retractable landing gear

Army budget

Substantially in the form reported by the Appropriations Committee the House of Representatives passed the War Department annual supply bill for the fiscal year 1935 and sent it to the Senate. Authorizations for Air Corps expenditure included $3,848,824 for experimental and research work an increase of $1,000,000 over the Budget estimate An additional $222 283, bringing the total to $8 486 600 was likewise proposed for the plane procurement program, which was revised by the Appropriations Committee with the concurrence of the Chief of the Air Corps The bill now calls for a total of 290 planes (62 attack, 57 pursuits 49 bombardments, and 122 non-fighting types) as compared with the original Budget estimate of 348 planes Because the revisions called for an increased number of bombardment planes, the most expensive of all types, it became necessary to reduce the total number Under the Signal Corps and Ordnance authorizations, the bill includes $255 796 for aircraft radio equipment, which is to be made available immediately, and $66,000 for aircraft armament $1 608,093 was appropriated for flying pay for Regular officers to cover 1 447 flight orders During the House discussion of the bill, an increase in the flying hours of Air Corps pilots was advocated without success by two vigorous Republican opponents of the Army Mail service, Representative Fish of New York and Representative Edith Rogers of Massachusetts On the motion of Representative Oliver of New York $25,000 was appropriated to conduct a survey of Governors Island in New York Harbor to consider the possibility of establishing an airport there. This appropriation was later recommended for elimination by House conferees discussing the bill with the Senate

When the Senate took up the bill $10,000,000 was added to Air Corps appropriations at President Roosevelt's request and for purposes unknown According to the *Army and Navy Journal* the money which is to be expended "in the discretion and under the direction of the President" will be used in part to construct an airplane factory at Dayton, Ohio, paralleling the Senate's appropriation of $4,000,000 for the naval aircraft factory (see page 118)

Preparedness

In the early months of 1934, the nations of the world candidly admitted for the first time since the Treaty of Versailles in 1919 that their efforts to persuade each other to disarm had failed and set about augmenting military and naval defenses, stressing in their parliaments the necessity for increased air strength Starting gun of what may prove to be a new race for armaments in Europe was Germany's official pronunciamento of her intention to rearm "in moderation" and to supply herself with an "adequate" air force These terms were specifically defined by General Goering, minister of aviation, to mean 300 000 ground troops exclusive of the 2 500 000 black shirt storm troops and an air force of at least 30 to 40 per cent of the combined air strength of her four neighbors France, Belgium, Czechoslovakia, and Poland. France promptly launched a rigid defense program calling for a three billion franc ($197,400,000) bond issue, of which 980,000,000 francs will be spent on fighting planes. Great Britain, though reluctant to abandon hope of international peace, none the less took up the challenge as Premier Baldwin declared in the House of Commons that if further efforts in behalf of armament limitation should prove fruitless, the government would see to it that in air power England would no longer be in a position of inferiority to any foreign country While the accelerated tempo of Europe's armament plans is decidedly significant as a commentary on the tense political situation, it must also be observed that the expenditures contemplated by France and Great Britain are not aggressively large France's money to be spent over a three year period will go mainly for replacements and for the development of planes of "quality rather than quantity" since the French Air Force though ranking high in numbers contains only about 1 000 planes which are up-to-date. Great Britain's air estimates for 1934-35 of £20 165,600 ($102 000,000) or £527,000 ($2,700,000) over last year will provide only four new air squadrons

Repercussion from France's newly-launched plan for dominance in the air was the opposition of the new air minister, General Denain, to ratification of the co-operative agreement between Air France and Lufthansa in regard to mail operations in the South Atlantic France's program of "invincibility in the air" gains significance from the fact that General Denain is the first professional military man ever appointed as Air Minister

In the United States, despite the fact that the War Department was unanimous in its belief that our air power should be augmented, there was sharp divergence of opinion between the General Staff and the Secretary of War on one hand and the Army Air Corps and Representative McSwain of the House Military Affairs Committee on the other, both as to the numbers of planes necessary for an effective air force, and as to whether the new air force would be as now under General Staff control or become a separate entity functioning independently of the General Staff The War Department modernization bill, calling for a G H G Air Force, and the McSwain bill demanding a total of 4,000 planes and a separate Air Force promotion list, both of which await the attention of the House of Representatives (AVIATION March pages 94-95) were shelved temporarily until after more dramatic revelations of the subcommittees investigating procurement.

Redress sought in court

On March 13 Transcontinental & Western Air, Inc., filed an appeal to the United States Circuit Court of Appeals from the decision of Federal Judge Knox of New York denying jurisdiction of T W A 's suit against Postmaster General Farley and Postmaster Kiely of New York to enjoin interference with its air mail route certificate (AVIATION, March, page 91) A statement from Richard W Robbins, president of the company, declared that T W A believes and is ready to seek to prove in court that the Postmaster General had neither statutory authority nor constitutional power nor any justification whatsoever to issue the annulment order, and that the charge of collusion, combination or corruption in the procuring or performance of T W A 's contract to carry the mail is unmitigated falsehood.

Brigadier General William Mitchell, who resigned from the Army in 1926 after a dispute over the aviation service, made a speech before the Foreign Policy Association in New York City on March 3 in which he charged among other things that Curtiss-Wright Corporation and United Aircraft and Transport Corporation had built up a powerful "air trust", and that neither corporation had done anything whatsoever to further improvement in aircraft or aircraft engines, but had deliberately held back on technical developments to avoid scrapping machinery Thomas A Morgan, president of Curtiss-Wright, called for a public retraction and, failing to get it, filed suit against General Mitchell for $200,000 for libel

I.C.C. for aviation

That air transport should be placed under the control of the Interstate Commerce Commission is the general recommendation of Joseph B. Eastman Federal Co-ordinator of Transportation in his second report to Congress on all transportation agencies in the United States The report originally proposed immediate transfer of airlines to the jurisdiction of the I.C.C , but Eastman concluded that in view of the turbid air mail situation his proposals for permanent regulation had better wait

Air merger

Corollary to the bitterly partisan dissensions which broke out over the air mail situation was the revival of the eminently debatable subject of consolidation of all governmental air activities Bombshell to the Senate was the speech made by Democratic Leader Robinson, fresh from a White House conference, who declared that civilian and military aviation must be unified under an "able and aggressive leadership." Naval aeronautics, as an integral part of fleet maneuvers were excluded from the suggested set up When General Mitchell was invited to lunch with the President, tongues wagged. Though rumors of immediate unification of aviation ensued, to be contested pro and con on every hand, no definite program issued from the Administration beyond reiteration of the fact that the President had ordered a detailed survey of American aviation, designed to give the United States a unified air policy The majority of army and navy officers, as well as operators of transport lines, which are regarded as a strong potential national defence arm, hold that such a merger of flying elements would be impractical since each branch of aviation is in itself a specialized science

U. S. transports for Europe

Newest franchise granted to Anthony H G Fokker's company in Amsterdam (AVIATION, March page 95) is the sales and distribution rights for all models manufactured by the Lockheed Corporation of Burbank, Cal , in all European countries, save Switzerland. The rights cover Great Britain and her colonies and Belgian and Dutch colonies A special agreement permits only the sale of the Electra to Russia

The sale of three Boeing 247 transports to Deutsche Lufthansa represents the first purchase of American-made high-speed multi-motored passenger planes by any foreign airline, although fast single engine ships have been sold to some extent abroad

A new Boeing pursuit plane was recently delivered to the Materiel Division, Air Corps, Wright Field for performance test, first of the pursuit type to possess the features of an inclosed cockpit and retractable landing gear

New equipment

A new fleet of 30 high-speed transports will fly American Airways when their current $2,000,000 equipment program is consummated Ten Douglas transports, ten Vultees, and ten Condors are on order for early delivery The Condors of which six are sleepers each with a dozen full-length berths, are fitted with a new nacelle and full N.A.C A cowling combination that first appeared on the bomber, which Commander Frank Hawks is now demonstrating to the Chinese Older Condors now in service will also be rearranged for the new cowl and equipped with Hamilton Standard controllable propellers

Intercollegiate aviation

The University of Minnesota Flying Club is drawing up a tentative constitution for a national association of college flying and glider clubs

Extension courses in various phases of air transport operations to meet the practical educational needs of persons employed in the aviation industry are now offered by the Boeing School of Aeronautics at Oakland, Cal A home study program was established a year ago specifically for employees of United Air Lines, which proved so successful that a demand arose for distribution to other companies

New services

American Airways on March 21 placed new fifteen passenger Curtiss Condors on their New York to Boston run, thereby reducing flying time to one hour thirty one minutes, twenty nine minutes faster than the previous time for the route

The Boston-Maine, Central-Vermont Airways established services between Montreal and Boston, with connections with half a dozen other New England cities, using ten-passenger tri-motored Stinsons

Funds for sportsmen pilots

Private flying will advance at full throttle if the Independent Aviation Operators succeed in getting the government aid they are seeking in a series of eight resolutions which were presented to President Roosevelt and also to the Congress The newly formed organization comprises operators of flying schools, aircraft sales and service agencies, and repair depots, and is headed by Oliver L Parks of East St Louis, with William Long of the Dallas School of Aviation and Howard Ailor of Waco Sales of New York, as the other officers. One of the resolutions asks the President to allocate from recovery funds $8,000,000 to stimulate the sale of aircraft. The government would contribute 33⅓ per cent of the price up to $1 000, to any citizen toward the purchase of an American made plane Under another resolution the President would allocate $4,000 000 out of which the Aeronautics Branch Director would pay up to $100 yearly to any private pilot or one holding a higher license grade upon submission of proof that he had flown 50 solo hours during one year without compensation To make flying less expensive for student

pilots it is recommended that the government pay 25 per cent of the tuition cost for students enrolled in accredited schools The I A O argues that while encouraging private flying, the government will at the same time strengthen the national defense

THORP HISCOCK, 42, vice-president in charge of technical development for United Air Lines and important leader in the technical field of air transport died in Chicago on March 17 of angina pectoris He had been associated with United Air Lines since 1928 when he served as air communications engineer for the Boeing division Contributing greatly to the development of two-way plane to ground radio telephony, he also aided in the development of other aids to flying

Personnel

C C Crockett, sales engineer of Kollsman Instrument Company, Brooklyn, N Y, is on a six weeks' trip to visit airlines and manufacturers throughout the country in a specially Kollsman equipped Waco plane

Maj J A Macready, formerly Chief of Flying Section, Engineering Division, Army Air Corps, at McCook Field, has resigned from the aviation department of the Shell Oil Company, to go into a different phase of aviation activity

SIDE SLIPS

By Robert R. Osborn

THE GODS who watch over Mount Everest were very much angered at the completion of a successful flight over the summit by British pilots last April This anger of the gods according to the natives of the Kingdom of Nepal, in the Himalaya mountains, was responsible for a recent very destructive earthquake upheaval in India which killed thousands of people and caused a great amount of damage

Before you laugh too loudly at this reasoning of an ignorant people try to explain to the natives of the Kingdom of Nepal why it should have been necessary to have had such a violent upheaval in American aviation —an upheaval which has cost the lives of Army pilots and has done a great amount of damage. The only logical reason we could offer them would be that the gods who watch over the Democratic party are angered that the great advances in air mail and passenger flying were accomplished during a Republican administration

We have been able to sit in on many of the hearings of the various House and Senatorial investigating committees recently, and have enjoyed them thoroughly—always having been a great lover of Gilbert and Sullivan operettas. The last few months seem to have been open season on any company or person connected with aviation with no limit on daily bags The senators and congressmen have had more darned fun,—and the poor Presidents and General Managers of aeronautical outfits have been wandering from one committee room to another answering the same questions in each room By now we are sure that each member of Congress knows what each official makes in salary, how much bonus he gets, if any, whether or not he is living with his own wife, and if he is guilty of the high crime of making money from a government contract. It seemed that one couldn't pass a single committee room door in either the House or Senate Office Buildings without hearing harsh words on aeronautical subjects In one room we would find the daily dog fighting exhibition between Senator Black and former Postmaster General Brown during every day of which Mr Brown would get on the tail of Mr Black and ride him to the ground. In another room Mr Delaney and his House Naval Affairs Committee were arriving at the conclusion that the contractors supplying the Navy with airplanes and engines were honest and that the Navy was getting its money's worth in a satisfactory manner In another section of the many ringed circus the Appropriations Committee was asking the same questions about open competitive bidding on government contracts which must have been asked in the first continental congress,—the only difference being that the questions are now being asked about airplane contracts instead of bids on powder horns In still another room the Military Affairs Committee was rapidly coming to the conclusion that Assistant Secretary of War Woodring was not nearly so black as he had been painted by a befuddled official. Still other investigations are under way in other committees but we haven t had an opportunity to drop in on them yet, to see if they are rearranging any of the words in the same old questions From our experiences thus far however we have been able to gether together the following simple rules which all aeronautical contractors to the government had better keep in mind if they are going to be safe from government investigations in the future

1 Never pay for anything you purchase You may be accused of 'paying tribute' to its manufacturer

2 Don't ever have an underground tunnel between your plant and the plant of an affiliated company, even if its purpose is to carry steam pipes from one building to another One committee jumped up and down and howled with glee when they found that there was an underground tunnel between the Vought and Hamilton Standard plants in Connecticut

3 Be very careful in selecting high officials for your company that their names cannot become confused The Curtiss-Wright officials had a little difficulty explaining that none of the tremendous income of Mr J P. Morgan had to be added to their overhead just because Mr Thomas A. Morgan happened to be their president

4 If another bull market should develop, or another aviation boom should hit Wall Street do not sell any of your stock to the speculators who will be willing to pay you any price for it That will be evidence of collusion and fraud

5 (And most important) Do not make more than a "fair" profit out of any one contract,—even if you have had overwhelming losses on ten previous contracts for the same type of material.

Every year we have additional evidence of the truth of that old quotation 'In the Spring a young man's fancy——" One of the younger test pilots for Curtiss has been making a series of tests on a new amphibion for the Navy, and lately, whenever he has returned from some runs over the speed course, it has been impossible to obtain any of the speed data, engine revs or other information until one has listened to a discussion of the beautiful daffodils and pussy willows which grow along the speed course Curtiss Company officials have been expecting to get daily flight reports in poetical form at any time now

We see that airline pilots in Germany are given a base pay depending on their years of service with the airline and the number of children in their families. If that system were in effect over here, think of the wonderful possibilities of congressional investigations then! "Are these seven children really yours, or did you adopt them in order to gyp the government out of more base pay?" "Please give us your overhead figures applying to each child back to 1926, with percentage of profit each year"

You will realize that there are plenty of other possible questions too, but AVIATION being the fine upstanding family magazine that it is we had better stop there

American airplane specifications

AVIATION does not assume responsibility for the figures given

Manufacturer	Designation	General A.T.C. number	Price at factory	Type	Number of seats	Power Plant Make of engine	Total rated hp	R.p.m. at rated hp	Fuel capacity (gal.)	Normal range (mi.)	Fuel consumption at cruising speed (gal. per hr.)	Propeller Diameter—in.	Weights Wing loading (lb per sq ft)	Power loading (lb per hp)	Weight empty with cooling water if used	Payload (lb)	Gross weight (lb)	Performance High speed (m p h)	Cruising speed (m.p.h.)	r.p.m. at cruising speed	Stalling speed (m p h)	Climb at sea level (ft p.m.)	Service ceiling (ft.)
SINGLE ENGINED PLANES WITH SEATS FOR FEWER THAN FOUR PERSONS																							
Aeronautical Corp. of America	Aeronca C-3	*396	1 890	O-CML	2	Aeronca	56	2 400	8	200	3 0	66	6 50	22 50	472	198	990	85	70	2 250	62	400	12 000
Aircraft Mechanics Inc	D-2	449	1 590	CML	2	Sz	45	1 250	7	160	3 3	72	5 60	21 80	598	173	992	95	78	1 950	30	650	12 000
Aircraft Mechanics Inc	A-14	105		OBL	3	Wa Ww	175		70	575			7 59	14 50	1 711		2 608	119	108		45	650	15 000
American Eagle Aircraft Corp.	Eaglet	450	1 525	OML	2	Sz	45	1 750			3 0		5 40	20 49	509	120	922	90	75		25		
Consolidated Aircraft Corp	Fleet 10	*374	4 951	OBL	2	K	125	1 925	24	515	7 5	96	8 95	15 42	1 029	265	1 680	115	95	1 725	42	900	15 300
Consolidated Aircraft Corp	Fleet 11	526	5 571	OBL	2	K	160	1 975	27	299	9 0	96	9 15	11 10	1 135	270	1 290	124	105	1 750	45	1 100	17 800
Curtiss-Wright Airplane Co	C-W 16-K	411	4 400	OBL	3	K	125	1 925	55	400	7 5	96	9 50	15 60	1 179	585	1 950	115	96		34	850	12 500
Curtiss Wright Airplane Co	C-W 16-E	*463	4 600	OBL	3	Wa Ww	175	2 000	35	550	10 3	102	10 40	12 50	1 357	395	2 150	155	115	1 250	48	1 200	17 500
Curtiss Wright Airplane Co	C-W A-14-D	442	10 895	OBL	3	Wr Ww	250	2 000	58	550	14 3	104	11 90	11 50	1 772	544	2 870	155	132	1 250	59	1 000	17 500
Curtiss Wright Airplane Co	C-W B-14-B	485	13 500	OBL	3	Wr Ww	530	2 000	66	550	17 5	102	12 40	9 50	2 008	448	3 097	170	145	1 250	57	1 600	20 000
Fairchild Aviation Corp	C-2-D	505	2 475	OML	2	Wr Gy	90	1 950	21	400	5 0	85	9 10	17 20	992	224	1 550	112	95	1 200	49	568	15 000
Fairchild Aviation Corp	C-2-A	*438	2 975	OML	2	Cir	95	2 100	21	400	3 1	85	9 10	16 50	928	229	1 550	115	98	1 900	49	600	15 000
Fairchild Aviation Corp	C-7 E	*515	3 925	OML	2	War	125	2 050	30	550	6 3	84	10 50	14 00	1 102	275	1 750	133	115	1 825	52	625	18 000
Fairchild Aviation Corp	C-7 F	*512	4 440	OML	2	War	145	2 050	50	500	7 5	84	10 50	12 10	1 155	244	1 750	145	122	1 850	52	840	20 000
Fairchild Aviation Corp	C 8-A	497	3 850	CML	2	War	125	2 050	50	520	6 3	90	9 95	14 80	1 172	244	1 850	128	110	1 850	51	662	18 000
Fairchild Aviation Corp	C-8-C	Pdg		CML	3	War	145	2 050	40	650	7 3	90	11 30	14 50	1 235	329	2 100	145	125	1 850	54	650	19 000
Great Lakes Aircraft Corp	2 T-1A	228	2 985	OBL	2	Cir	90	2 100	26	320	9 3	78	8 45	17 55	1 019	223	1 580	110	90	1 825	45	350	13 000
Great Lakes Aircraft Corp	2-R 1E	354	3 185	OBL	2	Cir Id	95	2 100	26	520	9 3	78	8 45	19 65	1 019	215	1 580	110	90	1 825	45	550	15 000
Hammond Aircraft Corp	Hammond 100.	428	2 995	OBL	3	K	100	1 810	50	400	6 5	96	2 00	20 10	1 250	382	2 010	108	90	1 750	38	900	14 000
International Aircraft Corp	CNA 40	495	1 275	OML	1	Con	57	2 550	7	160	2 7	60	6 50	18 20	454		925	85	72	2 550	43	420	11 000
International Aircraft Corp	LNA 40	487	1 250	OML	1	Con	57	2 550	9	250	2 7	60	5 19	18 90	459		700	60	70	2 500	31	450	12 000
International Aircraft Corp	LNB-4	456	1 095	OML	1	Heath	25	2 800	9	250	2 4	57	5 19	28 00	450		760	71	60	2 450	39	500	9 000
Kinner Airplane & Motor Corp	Kinner K	490		OML	2	K	100	1 810	24	590	9 0	90	8 42	12 00	1 119	250	1 700	104	90	1 700	35	800	14 000
Kinner Airplane & Motor Corp	Kinner B	*516		OML	2	K	125	1 925	55	400	8 7	93	9 20	15 00	1 219	248	1 875	110	100	1 725	40	900	15 000
Kinner Airplane & Motor Corp	Kinner B-1	522		OML	2	K	125	1 925	55	420	8 7	93	10 00	15 00	1 107	279	1 875	118	105	1 725	40	1 000	14 500
Kinner Airplane & Motor Corp	Kinner R	518		O-CML	2	K	160	1 975	48	593	11 0	96	15 50	15 50	1 590	272	2 170	155	125	1 775	55	800	14 000
Laird Airplane Co	LC-B-300	555	10 850	OBL	3	Wr Ww	500		76	550		108	10 50	18 10	1 950	590	5 020	150	120	1 850	45	1 000	22 000
Laird Airplane Co	LC-R 300	176	11 590	OBL	5	Wr Ww	300		76	550		114	15 50	10 50	1 922	390	5 010	175	155	1 850	55	1 500	20 000
Laird Airplane Co	LC-RW 300	372	14 250	OBL	5	Pwj	300		78	600		114	15 50	10 50	1 922	390	5 010	180	150	1 850	58	1 600	22 000
Lockheed Aircraft Corp	Altair (8-E)	352	25 000	CML	2	Pww	550	2 200	165	1 025	55 0	108	19 72	10 54	5 500	Var	5 800	230	205	2 000	65	1 500	22 000
Lockheed Aircraft Corp	Altair (8-D)	461	25 000	CML	1	Pww	550	2 200	165	1 025	35 0	108	19 72	10 54	5 530	Var	5 800	230	205	2 000	65	1 500	22 000
Monocoupe Corp	Lambert 90	*306	3 525	CML	2	Lam	90	2 575	28	540	5 7	86	11 50	19 90	889	292	1 519	116	100		40	900	18 000
Monocoupe Corp	Lambert 110	*327	4 495	CML	2	War	125	1 950	28	400	7 5	86	12 20	14 70	1 020	225	1 620	142	112			1 200	18 000
Monocoupe Corp	Lambert D-145		5 600	CML	2	War	145	2 050	56			86			1 228		1 860	170	140	1 900	50	1 500	
Northrop Corp	Gamma 2-D		31 000	OML	1-2	Wr Cy	715	1 950	340	1 800		114	19 20	9 60	3 600	3 400	7 000	225	205		50	1 600	24 600
Rearwin Airplanes Inc	Jr 4 000	469		OML	2	Aero	50			400	2 6		5 60	22 50	525		1 025	100	85			700	
Rearwin Airplanes Inc	Jr 5 100	481		OML	2	Sz	50								805		1 045						
Skylark Aircraft Corp	S-95		1,995	OBL	2	Cir Id	95	2 100	22	500	6 5	81	2 00	15 80	938	250	1 555	115	97	1 825	42	725	12 000
Stearman Aircraft Co	6-H	458		OBL	2	K	210	1 900	64	700	10 4	108	10 10	13 00	1,893	250	2,737	120	100	1 750	49	880	14 650
Stearman Aircraft Co	6-L	459		OBL	2	Ly	215	2 000	63	650	10 9	108	10 10	12 80	1,952	255	2,749	120	100	1 750	32	920	12,575
Stearman Aircraft Co	6-D	402		OBL	2	Pwj	300	2 000	65	490	15 0	108	10 54	9 50	1,925	265	2 814	137	115	1 700	55	1 250	18 100
Stearman Aircraft Co	80	504		OBL	1-2	Pwj	420	2 200	105	690	22 0	103	12 22	8 55	2 558	Var	5 500	175	150	1 950	57	1 500	20 000
Stearman Aircraft Co	81	*504		OBL	2	Pwj	420	2 200	155	1 055	20 0	102	14 55	9 52	2 585	340	4 000	170	140	1 910	60	1 100	17 000
Swallow Airplane Co.	TPK	186	1 285	OBL	2	K	100		28	250	2 5				1 240	120	1 200	100	85	1 250	35	850	15 600
Swallow Airplane Co.	TPW	253	1 885	OBL	2	War	125		28	250	7 5				1 240	120	1 239	103	85	1 250	35	850	15 000
Swallow Airplane Co.	Special HC	*399	3 295	OBL	3	Con	165		40	440	9 0				1 455	552	2 260	152	110		62	1 450	17 000
Taylor Aircraft Co	Cub E-2	455	1 425	O-CML	2	Con	37	2 550	9	5	5 0	99	5 10	25 00	530	402	952	85	75	2 550	39	500	12 000
Taylor Aircraft Co.	Cub F-2	Pdg	1 495	O-CML	2	Aero	40	2 050	9	5	5 0	24	5 20	21 00	545	405	950	92	85	1 850	38	600	15 500
Viking Flying Boat Co	Kitty Hawk B 8	*392		OBL	3	K	125	1 900	55	425	7 5	98	8 57	15 80	1,128	342	1,350	106	90	1 750	40	700	12 000
Waco Aircraft Co	KBA	480	3 585	O-CBL	2	K	100	1 900	40	500	6 8		8 21	19 03	1 259	341	1 985	101	86	1 750	60	425	10 500
Waco Aircraft Co.	RBA	468	4 195	O-CBL	2	War	110	1 850	60	450	7 0		8 21	18 05	1 250	350	1 985	105	91	1 210	40	500	12 800
Waco Aircraft Co	PBA	464	4 285	O-CBL	2	Ja	120	2 250	40	400	10 0		9 32	15 25		441	2 250	119	101	2 000	42	650	14 500
Waco Aircraft Co	UBA	479	4 895	O-CBL	2	Con	210	2 000	40	575	12 0		9 52	10 95		459	2 500	152	119	1 850	42	1,500	19 500
Waco Aircraft Co	PBF	491	4 415	O-CBL	3	Ja	120	2 250	40	400	10 0		9 52	15 33		516	2 500	119	101	2 000	62	650	14 500
Waco Aircraft Co	QCF	*418	4 985	OBL	3	Con	165	2 000	40				9 10	15 31	1,268	428	2 200	124	109	1 850	42	1 050	16 000
Waco Aircraft Co	UBF	*473	5 025	O-CBL	3	Con	210	2 000	40	575	12 0		9 52	10 95		484	2 500	152	115	1 850	42	1 500	19 500
SINGLE ENGINED PLANES WITH SEATS FOR MORE THAN THREE PERSONS																							
Airplane Development Corp	V-1			OML	8	Wr Cy	200	1 900	148			112	20 00	16 50	4 275	1 835	7 250	225	195		95	1 000	22 000
Aircraft Mechanics Inc	C-7	318		CML	4	Wr Ww	175		45	450	12 0	96	15 30	15 80	1 720	610	2 760	142	121		42	700	17 000
Beech Aircraft Co	B 17-C	Apl		CBL	4-5	Ja	225	2 000	50	650	12 0	99	11 50	14 00	2 000	542	3 150	170	160	1 900	55	1 000	15 000
Beech Aircraft Co	17 R		17 950	CBL	4-5	Wr Ww	420	2 150	145	1 000	23 0	105	13 90	10 20	2 700	800	4 500	200	120		60	1,500	20 000
Beech Aircraft Co	A 17 F	Pdg	24 500	CBL	4	Wr Cy	210	1 950	180	900	40 0	114	12 00	7 55	3 250	735	5 200	240	225	1 750	95	2,500	25 000
Bellanca Aircraft Corp	Pacemaker E	476	16 500	CML	6	Wr Ww	420	2 150	120	900	19 0	105	12 50	11 50	2,945	950	4 443	155	152	1 850	57	1 000	19 700
Bellanca Aircraft Corp	Skyrocket F 1	*459	19 600	CML	6	Pww	420	2 000	200	1 200	22 0	108	18 00	15 33	5 318	995	5 600	157	152	1 740	91	910	14 900
Bellanca Aircraft Corp	Skyrocket F 2	*462	19 800	CML	6	Pww	450	2 100	200	1 450	24 0	108	19 00	10 22	3 240	1 055	5 500	121	148	1 825	61	1,000	19 000
Bellanca Aircraft Corp.	Aircruiser	391	29 850	CQL	15	Wr Cy	575	1 900	200	725	55 0		14 70	19 63	5 220	2 880	9 590	140	122	1 650	59	700	14 000
Consolidated Aircraft Corp	Fleetster 17 A	486		CML	10	Wr Cy Pwh	600	1 950	146	600	55 0		17 80	10 80	3 850	2 000	6 500						
Consolidated Aircraft Corp	Fleetster 20-A	496		CML	8	Wr Cy Pwh	600	1 950	195	800	33 0		18 80	11 30	3 850	2 100	6 800						
General Aviation Mfg. Corp	GA 43	*Pdg		CML	12	Wr Cy Pwh	212	1 950	176	660	57 0	120	19 00	12 50	5 450	2 200	8 750	210	190		59	900	22,000
Lockheed Aircraft Corp	Vega 5-C	308	16 000	CML	7	Pww	450	2 100	96	550	27 0	108	17 02	10 55	2 225	Var	4 750	195	170	1 875	65	1 250	18 000
Lockheed Aircraft Corp	Orion 9-D	506	25 000	CML	7	Pww	550	2 200	116	720	33 0	108	19 72	10 54	3 325	Var	3 800	250	205	2 000	65	1 500	22 000
Northrop Corp	Delta 1-A		31 500	CML	9	Wr Cy	715	1 950	540	1 700		118	19 20	9 90	4 100	2,000	7 000	221	201		58	1 000	24 800
Stinson Aircraft Corp	Reliant SR 5	*Pdg	4 985	CML	4	Ly	225	2 100	50	490	13 9	102	13 72	14 55	2 150	575	3 225	138	120	1 950	58	625	14 500
Waco Aircraft Co	UKC	*Pdg	6,285	CBL	4	Con	210	2,000	50	425	13 0	102	11 60	15 53	1 680	910	2,000	142	128	1,900	49	1 000	14 000
Waco Aircraft Co	YKC	Pdg	6,285	CBL	4	Ja	225	2,000	50	425	15 0	102	11 90	15 35	1 680	910	2 000	142	128	1 900	49	1 000	14 000
Waco Aircraft Co	CJC	*Pdg	8 895	CBL	4	Wr Ww	250	2 000	70	540	19 0	102	12 50	12 80	1 921	951	5 200	152	155	1 800	52	1 100	19 000
MULTI-ENGINED TRANSPORT PLANES																							
Boeing Airplane Co	247	500		CML	12	2 Pww	1 050	2 125	95			120	15 10	11 50	8 400	2 598	12 950						
Boeing Airplane Co	247 D	Pdg		CML	12	2 Pww G	1 050	2 200	275	610	62 0	120	19 50	12 40	8 950	2 572	15,650						
Curtiss Wright Airplane Co	T 32 Condor	*501		CBL	18	2-Wr Cy	1 400	1 950	500	600	25 0	140	15 15	12 50	11 235	3 200	16 800	170	150	1 750	59	1 000	12 500
Douglas Aircraft Co Inc	DC-2	Pdg		CML	16	2 Wr Cy	1 420	1 950	510	1 225	95 0	138	19 20	12 60	12 000	3 560	17 880	210	195	1 850	61	1 090	25 200
Douglas Aircraft Co Inc	DC 2A	Pdg		CML	16	2 Pwh	1,400	2 150	510	1 225	95 0	158	19 20	12 20	12 080	5 560	17 000	210	195	1,950	61	1 000	23 200
Lockheed Aircraft Corp	Electra 10A	Apl	37 500	CML	12	2 Pwwj	800	2 200	200	800	48 0	99	20 25	10 21	5 655	Inc	9 400	215	190	2 000	65	1 550	20 000
Lockheed Aircraft Corp	Electra 10B	Apl	32 500	CML	12	2 Wr Ww	800	2 150	200	800	48 0	99	20 25	10 21	5 855	Inc	9 400	215	190	1 950	65	1 350	19 000
Stinson Aircraft Co	Model U	484	25 500	CML	11	3 Ly	720	2 000	140	400	40 0	99	19 12	12 92	9 055	2 145	9 500	140	119	1 800	50	825	15 000
AMPHIBIONS AND FLYING BOATS																							
Amphibions Inc	Privateer P 3-B		9 800	CMA	3	Con	210	2 000	56	400	3 5	10	14 50	15 24	2 250	410	3 200	115	94	1 900	58	500	10 000
Consolidated Aircraft Corp	Commodore	256		CMF	25	2 Pwh	1 150	1 950	650	1 000	60 0		15 80	15 50	10 410	5 300	17 900	128	104	1 700		900	10 000
Douglas Aircraft Co Inc	Dolphin			CMA	8	2-Pww	900	2 100	158	400	54 0	101	19 10	10 55	6 550	1 910	9 500	161	155	1 910	95	950	19 500
Sikorsky Aviation Corp	S-40	454		CMF	58	4 Pwh	2 500	2 000	1 066	900	140 0		18 5	14 8	21 000	Var	34 000	135	112	1 750	94	700	15 000
Sikorsky Aviation Corp	S-41	419		CMA	13	2 Pwh	1 150	2 000	520		80 0		12 5	11 1	8 072	Var	12 800	131	115	1 750	60	875	18 200
Sikorsky Aviation Corp	S 42			CMF	52	4 Pwh	2 200		1 220	1 200						Var	38 000						
Viking Flying Boat Co	V-2	361		OBF	4	Wr Ww	250	2 000	60	400	12 0	102	8 60	15 90	2 300	502	5 450	105	90	1 250	45	750	14 800
AUTOGIROS																							
Kellett Autogiro Corp	K-4	528	8 475	OCT	2	Con	210	2 000	42	300	12 0	106	1 73	11 15	1 910	655	2 545	114	90	1 800	28	725	12 000
Pitcairn Autogiro Co	PA 20	420		OL	2	K	125	1 925	27	280	9 0	96	1 65	14 12	1 190	214	1 770	88	70	1 550	0	550	7 200
Pitcairn Autogiro Co	PA-18	478		OL	2	K	160	1 975	50	280	8 5	100	1 99	11 92	1 554	180	1 910	100	80	1 580	0	990	10 500
Pitcairn Autogiro Co.	PA 19	509		CL	4	Wr Ww—Pwe	420	2 150	90	590	25 0	114	2.06	9 92	2 680	598	4 040	120	100	1 800	0	850	12 500

A —Amphibion
Aap —Aircraft Prod
AD —Alclad
Aer —Aerol
Aero —Aeromarine
Al —Aluminum
Apl —Applied
Apl —Applied for
Aut —Autofan
Aw —Aero Wheels
Bi —Biplane
Bo —Bolted
Bsp —Box spar
Bx —Bendix

C —Closed
Ca —Cable
Can —Cantilever
Cd —Cord
Cg —Corrugated
Ch —Challenger
Cir —Cirrus
Com —Compression
Con —Continental
Cq —Conqueror
Cs —Coiled Springs
Cu —Curtiss
Cv —Conventional
Cy —Cyclone

D —Duralumin
Dg —Douglas
Du —Dual
Ec —Eclipse
Ex —Extra
F —Flying boat
Fab —Fabric
G —Glued
Ge —Genet
Gu —Goodyear
Gr —Grease
Gt —Gov't Inst
Gy —Gipsy
Hr —Heudereau

Hs —Hasann
Ht —Heat treated
Hyd —Hydraulic
I —I section
Id —Inverted
In —Internal
Ja —Jacobs
K —Kinner
Kh —Kelsey Hayes
L —Landplane
Lam —Lambert
Lk —Lockheed
Lmd —Laminated
Lp —Low pressure

Ly —Lycoming
M —Monoplane
Mt —Metal
Mech —Mechanical
Men —Menasco
Mg —Mahogany
Mq —Monocoque
Ms —Mile statement
Na —Navigation
O —Open
Ol —Oleo
Old —Oildraulic
Op —Optional

Pd —Pedal
Pdd —Packard Diesel
Ply —Plywood
Pn —Pneumatic
Pud —Pneudraulic
Pr —Push Rod
Pwh —P & W Hornet
Pwj —P & W Wasp Jr
Pww —P & W Wasp
Q —Sesquiplane
R —Rubber
Ret —Retractable
Ru —Routed

Ri —Riveted
S —Steel
Ss —Stainless Steel
Sc —Shock Cord
Scd —Screwed
Sd —Stamped
Sh —Sheet
SL —Streamline
Sol —Solid
Sp —Spruce
Spl —Split Axle
Spr —Spring
St —Standard

Str —Straight Axle
Sx —Sackely
T —Tubing
Trd —Treadle
Trs —Truss
W —Wood
War —Warner
Wb —Wire Braced
Wh —Wheel
Wi —Wire
Wl —Welded
Wr —Wright
Ww —New Whirlwind

*Licensed also as float type seaplanes

Autogiro Notes †Rotor diameter ‡Disc loading

Continued on page 174

American airplane specifications [continued]

AVIATION does not assume responsibility for the figures given

Manufacturer and Designation	A.T.C. Numbers	General (†)			Area (Sq ft) (†)						Wings					Landing Gear						Fuselage or Hull			
											Spars		Ribs									Framework			
		Span	Length overall	Height overall	Wing	Ailerons	Fin	Rudder	Stabilizer	Elevators	Material	How fabricated	Material	How fabricated	Covering material	Type	Tread (in.)	Wheel type and size	Brakes	Shock unit landing gear and tail	Tail wheel	Material	How fabricated	Covering Material	Baggage wt. allowance (lb.)
SINGLE ENGINED PLANES WITH SEATS FOR FEWER THAN FOUR PERSONS																									
Aeronautical Corp. Aeronca C-3, PC-3	396	36' 0"	20' 0"	7'10"	142.2	15.2	6.2		14.9	12.5	Sp	Sol	Sp	G	Fab	Spl		Aw 7x4	No	Ol-Spr	Yes	ST	Wl	Fab	20
Aircraft Mechanics D-2	449	32' 9"	21' 7"	5' 8"	175.0	20.0	6.5		18.8	13.0	W	Sol	W	Trs	Fab	Spl	54	Aw 16x7.3	No		No	ST	Wl	Fab	3
Aircraft Mechanics A-14	103	36' 8"	24' 5"	9'10"	330.0	45.0	4.3		23.8	16.8	W	f	W	Trs	Fab	Spl	22	Bx 30x5	Bx	Sc		ST	Wl	Fab	
American Eagle Aircraft Co. Eaglet	450	34' 4"	21' 2"	8' 0"	164.4						W		W		Fab	Spl		Aw 16x2-3	No	Sc	No	ST	Wl	Fab	
Consolidated Fleet 10, 11	324, 326	28' 0"	21' 5"	7'10"	196.0	10.9	2.9	8.2	15.1	10.8	Sp	Land	D	Rv	Fab	Spl	27	Aw 650x10	Yes	Ol Spr	No	ST	Wl	Fab	40–55
Curtiss-Wright Sport Trainer	411, 463	28'10"	21' 1"	8'10"	206.0	17.6	5.0	2.2	18.5	12.7	Sp	Sol	Sp	Trs	Fab	Spl	76	Aw 6.5x10	Acp	Hyd	Yes	ST	Wl	Fab	
Curtiss-Wright Sportsman	442, 485	31' 0"	25' 6"	9' 2"	248.0	21.5	5.4	18.4	19.1	11.9	Sp	Sol	Sp	Trs	Fab	Spl	81	6.5x10	Acp	Hyd	Yes	ST	Wl	Fab	
Fairchild C-7 A, D, E, F	503, 458, 515, 517	32'10"	22' 7"	8' 0"	120.0	29.0	4.1		15.8	10.4	Sp	f	Sp, Ply	Trs	Fab	Spl	91	War 6.50x10	War	Spr	Yes	ST	Wl	Fab	24
Fairchild C-8-A, C	497, Pdg	35' 8"	23' 5"	7' 0"	170.0	24.6	4.2		16.0	15.8	Sp	f	Sp, Ply	Trs	Fab	Spl	110	War 6.50x10	War	Spr	Yes	ST	Wl	Fab	Var
Great Lakes 2T-1A, 2R-1 E	228, 354	26' 8"	20' 4"	7'11"	171.0	16.6	3.5	5.2	13.5	9.5	Sp	f	D	Sd	Fab	Spl	70	Wi 24x4	Bx	Ol	No	ST	Wl	Fab	
Hammond 100	428	30' 1"	25' 6"	9' 2"	290.0	27.3	4.5		24.4	16.9	Sp	Sol	Sp	Trs	Fab	Spl	102	Ant 7.50x10	Ant	Ol-Spr	Yes	ST	Wl	Fab	42
International CNA-40	495	26'10"	17' 3"	4' 6"	102.0	25.0	4.3	5.2	10.0	8.9	Sp	Sol	Sp	Trs	Fab	Sol	48	Int 16-4	Op	Sc-Spr	No	ST	Wl	Fab	
International LNA-40, LNB-4	487, 456	31' 3"	17' 3"	6' 2"	155.5	33.6	4.9	5.2	10.0	8.9	Sp	Sol	Sp	Trs	Fab	Spl	48	Int 16x4	Op	Sc-Spr	No	ST	Wl	Fab	2.16
Kinner K, B	490, 516	39' 0"	24' 2"	2' 0"	202.0	20.5	7.1		18.6	15.9	Sp	f	Sp	G	Fab	Spl	104	Aw 19x9x5	Hyd	Spr	Yes	ST	Wl	Fab	28
Kinner B-1	522	34' 5"	24' 2"	7' 6"	174.2	18.3	2.1		18.6	13.9	Sp	f	Sp	G	Fab	Spl	104	Aw 19x9x5	Hyd	Spr	Yes	ST	Wl	Fab	109
Kinner R	518	29' 1"	24' 2"	7' 9"	142.0	14.4	6.8		18.6	15.6	Sp	I	Sp	G	Fab	Wb	84	Ant 6.5x10	Ant	Spr	Yes	ST	Wl	Fab	102
Laird Whirlwind LC-B	353	34' 0"	25' 9"	9' 5"	295.0						Sp	Sol	Sp, Ply	Trs	Fab	Spl		30x5	Yes		Op	DT	Rv	Fab	50
Laird Speedwing LC-R, LCRW	126, 322	28' 0"	22' 9"	9' 0"	202.0						Sp	Sol	Sp, Ply	Trs	Fab	Spl		30x5	Yes		Op	DT	Rv	Fab	50
Lockheed Altair 8E, 8D	352, Apl	42' 9"	22'10"	9' 3"	294.1	22.4	11.0		38.0	21.6	Sp	Box	Sp	G	Sp, Ply	Ret	159	War 9.50x12	War	Lk	Yes	Sp	Mo	Sp, Ply	Var
Monocoupe Lambert 90, 110	327, 366	32' 0"	20' 4"	6'11"	132.3	15.5	4.1	5.8	10.6	9.2	Sp	Sol	Sp	G	Fab	Wi Bc	63	Acp 6.50x10	Acp	Old	Spr	ST	Wl	Fab	
Monocoupe D-145		32' 0"	20' 5"		129.2						Sp	Sol	Sp	G	Fab	Wi Bc						ST	Wl	Fab	
Northrop Gamma 2D		48' 0"	29'10"		365.0	21.0	9.0	11.0	37.4	19.4	D	Trs	D		D	Cant Sl	108	Bx 36x8	Bx	Ol, Pa	Yes	D	Mo	D	
Rearwin Jr	469, 481	36' 0"	21' 8"	2' 6"	179.5		4.4	2.0	14.8	12.2	Sp				Fab	Sol				R	No	ST	Wl	Fab	
Skylark S 95		28' 3"	22'10"	8' 0"	185.6	19.4	3.8	2.3	13.9	18.8	W	Sol	D	Sd	Fab	Spl	60	LP Aw 650x10	Ant	Ol R	Op	ST	Wl	Fab	50
Stearman 6-R, 6-L, 6-D	458, 402, 459	32' 0"	25' 1"	9' 9"	269.5	26.5	4.4	9.3	21.4	12.2	Sp	Sol	Sp	Trs	Fab	Sol	85	Bx 30x5	Bx	Ol	Yes	ST	Wl	Fab	
Stearman 80, 81	504	35' 0"	24' 8"	9' 9"	275.2	22.4	5.7	10.7	26.2	12.9	Sp	Sol	Sp	Trs	Fab	Spl	82	24" Sl	Bx	Ol Sp	Aw	ST	Wl	Fab	25–120
Swallow TP, K, TP-W	186, 253	30'11"	24' 1"	9' 4"	276.0		3.8		14.5	15.5	W	Sol	W	G	Fab	Spl	22	26x4	No	Sc		ST	Wl	Fab	
Swallow Special HC	599	31' 0"	22' 2"		240.0		2.2		25.0	16.0	W	Sol	W	G	Fab	Spl			Yes	Ol	Op	ST	Wl	Fab	
Taylor Cub E2, F2	455	35' 3"	22' 5"	6' 8"	183.0	18.0	3.0	2.0	18.0	11.0	Sp	Sol	Me	Rv	Fab	Spl	52	200x4	No	Sc	No	ST	Wl	Fab	
Viking Kittyhawk B-8	592	28' 4"	22' 6"	8' 8"	233.0	22.3	5.2	6.4	24.0	12.0	Sp	Ro	Sp	Trs	Fab	Spl	86	War 6.50x10	War	Ol	Yes	ST	Wl	Fab	10*
Waco Model A	460, 465, 464, 479	29' 6"	21'11"	8' 8"	242						Sp	Sel	Ply	G	Fab	Spl	21	Acp 6.50x10	Acp	Own	Yes	ST	Wl	Fab	
Waco Model F	491, 416, 473	29' 7"	20' 6"	8' 9"	242						Sp	Sol	Ply	G	Fab	Spl	21	Acp 6.50x10	Acp	Own	Yes	ST	Wl	Fab	
SINGLE ENGINED PLANES WITH SEATS FOR MORE THAN THREE PERSONS																									
Airplane Develop. Corp. Vultee V-1		48' 0"	35' 6"	9' 5"	361.5	39.5	9.9	14.1	38.6	32.5	D	Rv	D	Rv	AD	Ret			Yes		Yes	D	Mo	AD	475
Aircraft Mechanics C-7	318	36' 0"	26'10"	7' 9"	200.0						W	Box	W	Trs	Fab	Ret	22	Bx 24x4	Yes	Ol		ST	Wl	Fab	100
Beech B 17 C	Apl	32' 0"			225.0						Sp	Sol	Sp	Trs	WD	Ret	86	24" Sl	Ant	Hyd	Yes	ST	Wl	Fab, Al	152
Beech 17 R		34' 4"	24' 3"	8' 8"	323.0						S		W	Trs	Fab	Wb	86	27" Sl	Ant	Hyd	Yes	ST	Wl	D Fab	125
Beech A 17 F	Pdg	34' 4"			305.0	24.0	6.0				S		W	Trs	Fab	Wb	86	27" Sl	Ant	Hyd	Yes	ST	Wl	D Fab	225
Bellanca Pacemaker E	476	48' 6"	22'11"	8' 6"	275.0						Sp	Ro	Ply	G	Fab	Spl	98	9.50x12	Ant	Ol Sc	Yes	ST	Wl	Fab	100
Bellanca Skyrocket F-1, F-2	459, 462	50' 6"	27'11"	8' 6"	311.0						Sp	Ro	Ply	G	Fab	Spl	94	9.50x12	Ant	Ol Sc	Yes	ST	Wl	Fab	212
Bellanca Aircruiser	391	65' 0"	42' 9"	11' 2"	652.0						Sp	Ro	Ply	G	Fab		180	Aw 52x16	Go	Ol	Yes	ST	Wl	Fab	750
Consolidated 17A, 20-A	456, 494	50' 0"	34' 8"	12' 0"	318.1	43.4	13.5	15.2	29.1	20.0	Sp	Box	Sp	O	Ply	Spl	199	Aw 29x13-6	Go		Yes	O	Rv	D	
General Aviation GA-43	Pdg	53' 0"	42' 8"	12' 9"	460.0	30.0	52.0	16.5	43.1	48.4	Dl	Trs	ST D	Trs	D	Ret	68	Aw 50x13	Go	Hyd	Yes	D	Mo	D	500
Lockheed Vega 5C	508	41' 0"	27' 6"	9' 0"	279.1	22.4	12.5		31.5	16.0	Sp	Box	Sp	G	Ply	Spl	99	War 9.50x12	War	Lk	Yes	Sp	Mo	Ply	150
Lockheed Orion 9D	568	42' 9"	27'10"	9' 8"	294.1	22.4	11.0		38.0	21.6	Sp	Box	Sp	G	Ply	Ret	159	War 9.50x12	War	Lk	Yes	Sp	Mo	Ply	152
Northrop Delta 1A		48' 0"	52' 5"		365.0	21.0	9.0	11.0	52.4	19.4	D		AD			Can Sl	108	Bx 36x8	Bx	Ol Pa	Yes	Mo	Mo		
Stinson Reliant SR-5	Pdg	41' 0"	27' 5"	8' 6"	255.0	28.2	10.9	15.5	25.7	12.1	Sp	Ro	DT	Rv	Fab	Can	118	Aw 25x11-4	Hyd	Aer	Yes	ST	Wl	Fab	65
Waco Model UKC, YKC		33' 0"	24'10"	8' 6"	240.0						Sp	Sol	Sp	G	Fab	Spl	22	Arp	Acp		Yes	ST	Wl	Fab	100
Waco Model CJC		33' 0"	24' 6"	8' 6"	256.0						Sp	Sol	Sp	G	Fab	Spl	72	Arp	Acp		Yes	ST	Wl	Fab	141
MULTI-ENGINED TRANSPORT PLANES																									
Boeing 247, 247 D	500, Pdg	74' 0"	51' 4"	12' 2"	836.1		12.6	24.1	82.8	42.7	D	Rv	D	Rv	AD	Ret	207	Aw 42x15.00-16	Hyd	Ol	Yes	D	Mo	AO	300
Curtiss-Wright Condor T-32	501	82' 0"	48' 7"	16' 3"	1276.0	104.0	28.5	42.5	101.2	92.6	ST	Wl	D	Rv	Fab	Ret	243	Bx 15.00x16	Mech	Ol, Spr	Yes	ST	Wl	Fab	650
Douglas DC-2, DC-2A	Pdg	85' 0"	62' 0"	16' 0"	940.0	86.8	22.1	42.5	92.2	58.4	AD	Rv	D	Rv	AD	Ret	216	42x15-16	Bx	Pud	Yes	AL	Rv	AD	480
Lockheed Electra 10A, 10B	Apl	55' 0"	38' 7"	10' 1"	458.3	29.2	15.0	16.9	40.0	55.6	O	Rv	D	Rv	D	Ret	163	AW 35x15-6	Hyd	Aer	Yes	O	Mo	D	500
Stinson Model U	484	66' 2"	45' 3"	13' 6"	575.0	48.0	10.5	16.6	59.0	36.2	ST	Wl	D	Rv	Fab	Spl	199	Ant 12.5x14	Aut	Hyd	Yes	ST	Wl	Fab	
AMPHIBIONS AND FLYING BOATS																									
Amphibions Privateer P-3-B		42' 6"	30' 4"	12' 0"	224.0	22.4	12.0	11.6	18.0	18.0	Sp	Ro	SS	Wl	Fab	Hyd	122	Aw 8x10	Yes	Ol	Yes	ST	Wl	Fab, D	70
Consolidated Commodore	256	100'0"	61' 8"	15' 8"	1100.0	119.0	23.4	40.2	81.0	54.5	D	Rv	D	Rv	Fab							D	Rv	D	
Douglas Dolphin		60' 0"	45' 1"	17' 6"	592.0	40.5	28.2	12.1	42.0	31.2															
Sikorsky S-40	454	114'0"	76' 8"	23' 0"	1740.0	100.0	49.5	52.4	149.0	104.7	D	Trs	D	Trs	Fab							D	Rv	AD	
Sikorsky S-41	418	78' 9"	45' 2"	15' 3"	729.0	60.0	12.6	22.6	60.3	34.2	O	Trs	D	Trs	Fab	Hyd	135	Gu	Own	Hyd	Yes	D	Rv	AD	
Sikorsky S-42		114'2"																				D	Rv	AD	
Viking Flying Boat V-2	361	42' 4"	29' 4"	10' 4"	801.5	42.1	4.0	13.0	32.2	22.5	Sp	Box	Mg, Ply	G	Fab							W	G Scd	Ply	24
AUTOGIROS																									
Kellett K-4	523	[1]41' 6"	19'11"	12' 4"	63.0	18.7	5.1	2.6	12.0	22.9	W	Sol	Ply	G	Ply	Spl	144	6.50x7		War	Yes	ST	Wl	Fab	25
Pitcairn PA-20	420	[1]37' 0"	18' 7"	11'10"	50.0	15.1	5.6		9.1	13.0	Ply	G	Ply	G	Fab	Trcd	120	6.50x10	Hyd	Hyd	Yes	ST	Wl	Fab	44
Pitcairn PA-18	478	[1]38' 4"	22' 5"	11' 4"	55.0		9.5		11.0	12.5	Ply	G	Ply	G	Fab	Trcd	120	6.50x10	Hyd	Hyd	Yes	ST	Wl	Fab	10
Pitcairn PA-19	509	[1]50' 0"	57' 7"	13'10"	95.5	29.6	12.5		16.0	17.4	ST Ply	Wl, G	Ply	O	Fab	Can	144	9.50x12	Hyd	Hyd	Yes	ST	Wl	Al Fab	80

A —Amphibion
Acp —Aircraft Prod.
AD —Alclad
Aer —Aerol
Aero —Aeromarine
Al —Aluminum
Apl —Applied for
Ant —Autofan
Aw —Air Wheels
B —Biplane
Bo —Bolted
Box —Box spar
Bx —Bendix
C —Closed
Ca —Cable
Can —Cantilever
Cd —Cord
Cg —Corrugated
Ch —Challenger
Cir —Cirrus
Com —Compression
Con —Continental
Cq —Conqueror
Cs —Coiled Springs
Cu —Curtiss
Cv —Conventional
Cy —Cyclone
D —Duralumin
Do —Douglas
Du —Dual
En —Ensign
Ex —Extra
F —Flying boat
Fab —Fabric
G —Glued
Ge —Genet
Go —Goodyear
Gr —Gram
Gt —Gov't test
Gy —Gipsy
He —Henderson
Hs —Hispano
Ht —Heat treated
Hyd —Hydraulic
I —I section
In —Internal
Id —Inverted
Jo —Jacobs
K —Kinner
Kh —Kelsey Hayes
L —Landplane
Lam —Lambert
Lk —Lockheed
Lmd —Laminated
Lp —Low pressure
Ly —Lycoming
M —Monoplane
Me —Metal
Mech —Mechanical
Men —Menasco
Mg —Mahogany
Mo —Monocoque
Ms —Mfr's statement
Na —Navigation
O —Open
Ol —Oleo
Old —Oildraulic
Op —Optional
Pe —Pedal
Pdd —Packard Diesel
Ply —Plywood
Pn —Pneumatic
Pnd —Pneudraulic
Pr —Push Rod
Pwh —P & W Hornet
Pwj —P & W Wasp Jr
Pww —P & W Wasp
Q —Sesquiplane
R —Rubber
Ret —Retractable
Ro —Routed
Rv —Riveted
S —Steel
SS —Stainless Steel
Sc —Shock Cord
Scd —Screwed
Sd —Stamped
Sh —Sheet
Sl —Streamline
Sol —Solid
Sp —Spruce
Spl —Split Axle
Spr —Spring
St —Standard
Str —Straight Axle
Sz —Szekely
T —Tobias
Trcd —Treadle
Trs —Truss
W —Wood
War —Warner
Wb —Wire Braced
Wh —Wheel
Wi —Wire
Wl —Welded
Wr —Wright
Ww —New Whirlwind

*Licensed also as float type seaplanes (†) Minor variations may occur among certain ships of same model designation

Autogiro Notes—[1]Rotor diameter [2]Disc loading

American engine specifications

AVIATION does not assume responsibility for the figures given

Manufacturer	Model	Cooling System	Cylinder Arrangement	Propeller Drive	Rating				Weights		Bore and stroke (in.)	Displacement cu. in.	Compression Ratio	B.M.E.P.	Blower Ratio	Dimensions			Guaranteed fuel consumption at rated hp (lb. hp. hr.)	Oil Consumption (lb. hp. hr.)	Valve mechanism	Cylinder construction (See footnote)	No. valves per cyl.	Make spark plugs supplied with engine	Ignition	Carburetion	Starter	Are exhaust manifolds provided?	Shipping wt. crated lb.	D. of C. License Number
					H.P.	at R.P.M.	at Altitude ft	Octane Fuel	Total dry without hub or starter	lb. per hp						Diam. of Mounting Ring (in.)	Ht. or O.D. (in.)	Length (in.)												
Aeromarine Pl. & Motor Co.	Aeromarine AR 3	A	3-Rad	D	50	2125	S L		150	3.0	4⅛x4	180	5.0	114			32¼	30	.55	.002	Prr	Al S	2	BG	2 B	1 Sg	Op	Yes	226	24
Aeromarine Pl. & Motor Co.	Aeromarine AR-3-40	A	3-Rad	D	40	2050	S L		150	3.5	4⅛x4	180	5.0	114			36¾	30	.55	.002	Prr	Al S	2	BG	2 B	1 Sg	Op	Yes	226	119
Aeronautical Corp. of America	Aeronca E 113A	A	2-Hopp	D	36	2400	S L		110	3.0	4¼x4	113	5.1	105			24	24	.52	.012	Prr	Al S	2	B	1 B	1 Z		No	100	21
Continental Aircraft Eng. Co.	A-40-2	A	4-Hopp	D	37	2550	S L		144	3.9	3⅞x3⅝	115	5.2	100		.855	19⅝	22⅛	.60	.025	Lh	Al C	2	BG	1 B-Sc	1 Sg	No	No		23
Continental Aircraft Eng. Co.	A-70-2	A	7-Rad	D	165	2000	S L		390	2.4	4⅝x4⅝	544	5.4	120		20	42¾	32⅜	.55	.025	Prr	Al S	2	BG	2 Sc	1 Sg	Op	Yes		22
Continental Aircraft Eng. Co.	R-670-A	A	7-Rad	D	210	2000	S L		425	2.0	5⅛x4⅝	668	5.4	125		30	42¾	32⅜	.55	.025	Prr	Al S	2	BG	2 Sc	1 Sg	Op	No		80
International Aircraft Corp.	Heath B-4	A	4-L	D	25	2800	S L		115	4.7	2⅞x3¾		4.5				24	25	.65	.019	Lh	C	2		1 B	1 Z	No	No		
Jacobs Aircraft Engine Co.	LA-1	A	7-Rad	D	170	2125	S L		390	2.2	4¼x4½	528	4.8	112		14	44	33	.55	.012	Prr	Al S	2	Ch	2 Sc	1 Sg	Op	Yes	660	31
Jacobs Aircraft Engine Co.	L-4	A	7-Rad	D	225	2000	S L		415	1.8	5¼x5	757	5.3			16	44	52	.55	.020	Prr	Al S	2	BG	2 B-Sc	1 Sg	Op	No	650	Pdg
Kinner Airplane & Motor Co.	K-5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Kinner Airplane & Motor Co.	B-5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Kinner Airplane & Motor Co.	R-5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Kinner Airplane & Motor Co.	C-5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Kinner Airplane & Motor Co.	C-7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	R-266	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lycoming Mfg. Co.	R-680	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lycoming Mfg. Co.	R-680-2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lycoming Mfg. Co.	R-680-4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lycoming Mfg. Co.	R-680-6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lycoming Mfg. Co.	R-680-7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lycoming Mfg. Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lycoming Mfg. Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Menasco Motors Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Menasco Motors Co.	Pirate B-4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Continued on page 120

American engine specifications (continued)

AVIATION does not assume responsibility for the figures given

					Rating				Weights							Dimensions														
Manufacturer	Model	Cooling System	Cylinder Arrangement	Propeller Drive	H P	at R P M	at Altitude ft	Octane Fuel	Total dry without hub or starter	lb per hp	Bore and stroke (in.)	Displacement cu in	Compression Ratio	B M E P	Blower Ratio	Dia. of Mounting Ring (in.)	Ht or O D (in.)	Length (in.)	Guaranteed fuel consumption at rated hp (lb hp. hr.)	Oil Consumption (lb hp-hr.)	Valve mechanism	Cylinder construction (See footnote)	No valves per cyl	Make spark plugs supplied with engine	Ignition	Carburetion	Starter	Are exhaust manifolds provided	Shipping wt. crated lb.	D of C License Number
Menasco Mfg Co	Pirate C-4	A	4IdI	D	125	2175	S L		288	2 30	4¾x5⅛	363	5 8	125		11⅝	28	47¾	50	027	prr	Al Ni	2	BG	2 B	1 St	Ec	No	443	67
Menasco Mfg Co	Buccaneer B-6	A	6IdI	D	160	1975	S L		355	2 20	4½x5⅛	489	5 5	130		11⅝	28	59⅞	54	006	prr	Al Ni	2	Ch	2 B	1 St	Ec	No	570	68
Menasco Mfg Co	Buccaneer B-6S-5	A	6IdI	D	200	2125	S L		415	2 00	4½x5⅛	489	5 5	157		15	28¾	58⅞	60	010	prr	Al Ni	2	BG	2 B	1 St	Ec	No	550	
Menasco Mfg Co	Pirate C-4S	A	4IdI	D	155	2175	S L		305	1 95	4¾x5⅛	363	5 8	157		30¼	28⅝	47⅝	60	010	prr	Al Ni	2	BG	2 B-Sc	1 St	Ec	No	457	
Michigan Aero Eng Corp	Rover	A	4IdI	D	75	1975	S L		228	3 05	4x5	247	5 1	113		14	31⅞	52⅝	55	010	prr	Al Ni	2	AC	2 Sc	1 St		Yes	370	37
Pratt & Whitney Aircraft Corp	Wasp Jr TB	A	9-Rad	D	320	2000	S L	75	585	1 82	5³⁄₁₆x5³⁄₁₆	985	5 0	120	6 0	23⅝	45¼	41⅞	55	035	prr	Al S	2	BG-HT	2 Sc	1 St	Ec	No	Var	113
Pratt & Whitney Aircraft Corp	Wasp Jr TB	A	9-Rad	D	400	2200	S L	80	585	1 46	5³⁄₁₆x5³⁄₁₆	985	6 0	146	8 0	23⅝	45¼	41⅞	55	035	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	85
Pratt & Whitney Aircraft Corp	Wasp Jr SB	A	9-Rad	D	400	2200	5000	80	585	1 46	5³⁄₁₆x5³⁄₁₆	985	6 0	146	10 0	23⅝	45¼	41⅞	55	035	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	Pdg
Pratt & Whitney Aircraft Corp	Wasp C1	A	9-Rad	D	420	2000	S L	75	725	1 71	5¾x5¾	1344	5 25	124	7 0	23⅝	51⅛	42⁹⁄₃₂	55	035	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	14
Pratt & Whitney Aircraft Corp	Wasp SC1	A	9-Rad	D	450	2100	4000	80	725	1 60	5¾x5¾	1344	5 25	126	10 0	23⅝	51⅛	42⁹⁄₃₂	55	035	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	58
Pratt & Whitney Aircraft Corp	Wasp S1 D1	A	9-Rad	D	525	2200	3000	80	730	1 39	5¾x5¾	1344	6 0	141	10 0	23⅝	51⅛	42⁹⁄₃₂	55	035	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	90
Pratt & Whitney Aircraft Corp	Wasp S1-D1-G	A	9-Rad	G^1	525	2200	3000	80	825	1 52	5¾x5¾	1544	6 0	141	10 0	25⅝	51⅛	47⁹⁄₃₂	55	055	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	90
Pratt & Whitney Aircraft Corp	Wasp S2-D1	A	9-Rad	D	460	2200	3000	75	730	1 59	5¾x5¾	1344	5 25	123	8 0	23⅝	51⅛	42⁹⁄₃₂	55	055	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	Pdg
Pratt & Whitney Aircraft Corp	Wasp S2-D1-G	A	9-Rad	G^1	460	2200	3000	75	825	1 79	5¾x5¾	1344	5 25	123	8 0	23⅝	51⅛	47⁹⁄₃₂	55	035	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	Pdg
Pratt & Whitney Aircraft Corp	Wasp T1 D-1	A	9-Rad	D	500	2100	S L	80	730	1 46	5¾x5¾	1344	6 0	140	8 0	23⅝	51⅛	42⁹⁄₃₂	55	035	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	91
Pratt & Whitney Aircraft Corp	Wasp SE	A	9-Rad	D	500	2200	11,000	82	730	1 46	5¾x5¾	1344	6 0	134	14 0	23⅝	51⅛	42⁹⁄₃₂	55	055	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	
Pratt & Whitney Aircraft Corp	Wasp S1E	A	9-Rad	D	500	2200	5000	62	730	1 46	5¾x5¾	1344	6 0	134	12 0	23⅝	51⅛	42⁹⁄₃₂	55	035	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	
Pratt & Whitney Aircraft Corp	Hornet SD1	A	9-Rad	D	575	2050	2000	73	870	1 51	6⅛x6⅜	1690	5 0	132	8 0	23⅝	55⅛	45⁹⁄₃₂	55	055	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	114
Pratt & Whitney Aircraft Corp	Hornet SD1-G	A	9-Rad	G^1	575	2150	3000	75	965	1 68	6⅛x6⅜	1690	5 0	125	8 0	23⅝	55⅛	50¹³⁄₆₄	55	055	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	115
Pratt & Whitney Aircraft Corp	Hornet S1 D1	A	9-Rad	D	525	2000	4000	75	870	1 66	6⅛x6⅜	1690	5 0	123	8 0	23⅝	55⅛	45⁹⁄₃₂	55	035	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	116
Pratt & Whitney Aircraft Corp	Hornet T2-D1	A	9-Rad	D	635	2000	S L	80	870	1 37	6⅛x6⅜	1690	6 0	149	10 0	23⅝	55⅛	45⁹⁄₃₂	55	055	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	99
Pratt & Whitney Aircraft Corp	Hornet S3-D1	A	9-Rad	D	645	2100	3000	80	870	1 35	6⅛x6⅜	1690	6 0	151	10 0	23⅝	55⅛	45⁹⁄₃₂	60	035	prr	Al S	2	BG-HT	2 Sc	1 St	Ec	No	Var	100
Pratt & Whitney Aircraft Corp	Hornet S3-D1-G	A	9-Rad	G^1	650	2150	3000	80	965	1 48	6⅛x6⅜	1690	6 0	142	10 0	23⅝	55⅛	50¹³⁄₆₄	60	055	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	117
Pratt & Whitney Aircraft Corp	Hornet S4-D1	A	9-Rad	D	650	2150	3000	80	870	1 34	6⅛x6⅜	1690	6 0	147	18 0	23⅝	55⅛	45⁹⁄₃₂	60	035	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	
Pratt & Whitney Aircraft Corp	Hornet T1-D1	A	9-Rad	D	675	2000	S L	87	870	1 29	6⅛x6⅜	1690	6 0	155	10 0	23⅝	55⅛	45⁹⁄₃₂	55	055	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	92
Pratt & Whitney Aircraft Corp	Hornet T1 D1-G	A	9-Rad	G^1	675	2150	S L	87	965	1 45	6⅛x6⅜	1690	6 0	142	10 0	23⅝	55⅛	50¹³⁄₆₄	60	055	prr	Al S	2	BG-HT	2 Sc	1 St	Ec	No	Var	109
Pratt & Whitney Aircraft Corp	Hornet SD	A	9-Rad	D	675	2000	6000	87	865	1 28	6⅛x6⅜	1690	6 5	154	12 0	23⅝	54⅛	46	60	055	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	106
Pratt & Whitney Aircraft Corp	Hornet S D-G	A	9-Rad	G^1	700	2150	6500	87	960	1 37	6⅛x6⅜	1690	6 5	155	12 0	23⅝	54⅛	50¹³⁄₆₄	60	055	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	105
Pratt & Whitney Aircraft Corp	Twin Wasp Jr S1A-G	A	14-Rad S	$G^{1,2}$	650	2400	7000	80	925	1 50	5³⁄₁₆x5³⁄₁₆	1535	6 0	140	10 0	23⅝	45⅛	53²³⁄₆₄	65	055	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	Pdg
Pratt & Whitney Aircraft Corp	Twin Wasp Jr S2A-G	A	14-Rad S	$G^{1,2}$	700	2500	10,000	87	975	1 39	5³⁄₁₆x5³⁄₁₆	1535	6 5	142	11 0	23⅝	45⅛	53²³⁄₆₄	65	055	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	Pdg
Pratt & Whitney Aircraft Corp	Twin Wasp SA-G	A	14-Rad S	G^1	850	2400	5000	80	1150	1 34	5½x5½	1830	6 0	135	10 0	23⅝	47⅛	56⁵⁄₁₆	60	055	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	Pdg
Pratt & Whitney Aircraft Corp	Twin Wasp S1A-G	A	14-Rad S	G	800	2400	6500	87	1150	1 44	5½x5½	1830	6 5	144	11 0	23⅝	47⅛	56⁵⁄₁₆	60	055	prr	Al S	2	BG HT	2 Sc	1 St	Ec	No	Var	Pdg
Warner Aircraft Corp	Scarab Jr	A	5 Rad	D	90	2025	S L		230	2 5	4¼x4¼	301	5 2	115		17	36⁵⁄₁₆	25½	55	020	prr	Al S	2	AC	2 Sc	1 Hy	Ec	No	485	54
Warner Aircraft Corp	Warner Scarab	A	7 Rad	D	125	2050	S L		285	2 25	4¼x4¼	422	5 2	114		17	36⁵⁄₁₆	28⅞	50	010	prr	Al S	2	AC	2 Sc	1 St	Ec	No	505	2
Warner Aircraft Corp	Super Scarab	A	7 Rad	D	145	2050	S L		300	2 05	4⅝x4¼	499	5 5	114		17	36⁵⁄₁₆	28⅞	55	025	prr	Al S	2	AC	2 Sc	1 Z	Ec	No	530	104
Wright Aeronautical Corp	Whirlwind 175	A	5-Rad	D	175	2000	S L	73	410	2 5	5x5½	540	5 1	129	2 05	18¼	45	41⅞	55	025	prr	Al S	2	BG	2 Sc	1 St	Ec	Yes	925	23
Wright Aeronautical Corp	Whirlwind 250	A	7-Rad	D	250	2100	S L	75	490	1 96	5x5½	756	5 1	151	7 05	19⅛	45	41⅞	55	025	prr	Al S	2	BG	2 Sc	1 St	Ec	Yes	1005	26
Wright Aeronautical Corp	Whirlwind 285	A	7-Rad	D	285	2100	S L	75	500	1 76	5x5½	756	6 1	141	7 05	19⅛	45	41⅞	55	025	prr	Al S	2	BG	2 Sc	1 St	Ec	Yes	1005	94
Wright Aeronautical Corp	Whirlwind 330	A	9-Rad	D	330	2000	S L	75	575	1 72	5x5½	973	5 1	155	7 8	19⅛	45	41²⁷⁄₃₂	55	025	prr	Al S	2	BG	2 Sc	1 St	Ec	Yes	1105	29
Wright Aeronautical Corp	Whirlwind 330-G	A	9-Rad	$G^{2,4}$	330	2000	S L	75	650		5x5½	973	5 1	155	7 8	19⅛	45	Var	55	025	prr	Al S	2	BG	2 Sc	1 St	Ec	Yes		21
Wright Aeronautical Corp	Whirlwind 365	A	9-Rad	D	365	2100	S L	75	590	1 62	5x5½	973	6 1	142	7 8	19⅛	45	41²⁷⁄₃₂	55	025	prr	Al S	2	BG	2 Sc	1 St	Ec	Yes	1115	87
Wright Aeronautical Corp	Whirlwind 365-G	A	9-Rad	$G^{2,4}$	365	2150	S L	75	645		5x5½	973	6 1	142	7 8	19⅛	45	Var	55	025	prr	Al S	2	BG	2 Sc	1 St	Ec	Yes		87
Wright Aeronautical Corp	Whirlwind 420	A	9-Rad	D	420	2150	S L	80	590	1 40	5x5½	973	6 1	159	10 15	19⅛	45	41²⁷⁄₃₂	55	025	prr	Al S	2	BG	2 Sc	1 St	Ec	Yes	1115	78
Wright Aeronautical Corp	Whirlwind 420-G	A	9-Rad	$G^{2,4}$	420	2200	S L	80	645		5x5½	973	6 1	159	10 15	19⅛	45	Var	55	025	prr	Al S	2	BG	2 Sc	1 St	Ec	Yes		64
Wright Aeronautical Corp	Whirlwind R 1510 B-1	A	14-Rad S	D	700	2100	S L	87	910	1 3	5x5½	1512	6 2		5 95	22⅝	45	46¹³⁄₁₆	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No	1570	
Wright Aeronautical Corp	Whirlwind SR 1510 B-1G	A	14-Rad S	G^5	745	2300	2800	82	950	1 2	5x5½	1512	6 2		5 95	22⅝	45	48⅝	55	035	prr	Al S	2	BG	2 Sc	1 St	Ec	No	1630	
Wright Aeronautical Corp	Cyclone R-1820-F1	A	9-Rad	D	715	1950	S L	82	910	1 27	6⅛x6⅞	1823	6 4	159	5 95	23⅝	53¾	43⅝	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No	1560	89
Wright Aeronautical Corp	Cyclone R-1820-F1-G	A	9-Rad	$G^{2,4}$	715	1950	S L	82	1025		6⅛x6⅞	1823	6 4	159	5 95	23⅝	53¾	Var	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No		89
Wright Aeronautical Corp	Cyclone SR-1820-F2	A	9-Rad	D	735	1950	4000	82	910	1 24	6⅛x6⅞	1823	6 4		7 0	23⅝	53¾	43⅝	55	035	prr	Al S	2	BG	2 Sc	1 St	Ec	No	1560	98
Wright Aeronautical Corp	Cyclone SR-1820-F2-G	A	9-Rad	$G^{2,4}$	735	1950	4000	87	1025		6⅛x6⅞	1823	6 4		7 0	23⅝	53¾	Var	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No		98
Wright Aeronautical Corp	Cyclone SR-1820-F3	A	9-Rad	D	710	1950	2000	82	910	1 29	6⅛x6⅞	1823	6 4		8 31	23⅝	55⅛	43⅝	55	035	prr	Al S	2	BG	2 Sc	1 St	Ec	No	1560	103
Wright Aeronautical Corp	Cyclone SR-1820-F3-G	A	9-Rad	$G^{5,6}$	710	1950	2000	87	1025		6⅛x6⅞	1823	6 4		8 51	23⅝	55⅛	Var	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No		103
Wright Aeronautical Corp	Cyclone R-1820-F11	A	9-Rad	D	690	1950	S L	60	910	1 32	6⅛x6⅞	1823	5 75	154	5 95	23⅝	55⅛	45⅝	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No	1560	97
Wright Aeronautical Corp	Cyclone R-1820-F11-G	A	9-Rad	$G^{5,6}$	690	1950	S L	60	1025		6⅛x6⅞	1823	5 75	154	5 95	23⅝	55⅛	Var	55	035	prr	Al S	2	BG	2 Sc	1 St	Ec	No		97
Wright Aeronautical Corp	Cyclone SR-1820-F31	A	9-Rad	D	670	1950	2500	80	910	1 36	6⅛x6⅞	1823	6 4		5 95	23⅝	55⅛	45⅝	55	035	prr	Al S	2	BG	2 Sc	1 St	Ec	No	1560	101
Wright Aeronautical Corp	Cyclone SR-1820-F31-G	A	9-Rad	$G^{5,6}$	670	1950	2500	80	1025		6⅛x6⅞	1823	6 4		5 95	23⅝	55⅛	Var	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No		101
Wright Aeronautical Corp	Cyclone SR-1820-F32	A	9-Rad	D	675	1950	6300	80	910	1 2	6⅛x6⅞	1823	6 4	159	7 0	23⅝	55⅛	45⅝	55	035	prr	Al S	2	BG	2 Sc	1 St	Ec	No	1560	Pdg
Wright Aeronautical Corp	Cyclone SR-1820-F32-G	A	9-Rad	$G^{5,6}$	625	1950	6300	80	1025		6⅛x6⅞	1823	6 4	159	7 0	23⅝	55⅛	Var	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No		
Wright Aeronautical Corp	Cyclone SR-1820-F33	A	9-Rad	D	650	1950	9500	80	910	1 41	6⅛x6⅞	1823	6 4		8 31	25⅝	55⅛	45⅝	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No	1560	110
Wright Aeronautical Corp	Cyclone SR-1820-F33-G	A	9-Rad	$G^{5,6}$	650	1950	9500	80	1025		6⅛x6⅞	1823	6 4		8 51	23⅝	55⅛	Var	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No		118
Wright Aeronautical Corp	Cyclone R-1820-F21	A	9-Rad	D	660	1950	S L	75	910	1 38	6⅛x6⅞	1823	5 3		5 95	23⅝	55⅛	45⅝	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No	1560	93
Wright Aeronautical Corp	Cyclone R-1820-F21-G	A	9-Rad	$G^{5,6}$	650	1950	S L	75	1025		6⅛x6⅞	1823	5 5		5 95	23⅝	53¾	Var	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No		93
Wright Aeronautical Corp	Cyclone SR-1820-F41	A	9-Rad	D	650	1900	4500	75	910	1 46	6⅛x6⅞	1823	6 4		5 95	23⅝	55⅛	45⅝	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No	1560	102
Wright Aeronautical Corp	Cyclone SR-1820-F41-G	A	9-Rad	$G^{5,6}$	620	1950	4500	73	1025		6⅛x6⅞	1823	6 4		5 95	23⅝	55⅛	Var	55	035	prr	Al S	2	BG	2 Sc	1 St	Ec	No		102
Wright Aeronautical Corp	Cyclone SR-1820-F42	A	9-Rad	D	625	1950	7200	73	910	1 2	6⅛x6⅞	1823	6 4	159	7 0	23⅝	55⅛	45⅝	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No	1560	Pdg
Wright Aeronautical Corp	Cyclone SR-1820-F42-G	A	9-Rad	$G^{5,6}$	625	1950	7200	73	1025		6⅛x6⅞	1823	6 4	159	7 0	23⅝	54¼	Var	55	055	prr	Al S	2	BG	2 Sc	1 St	Ec	No		
Wright Aeronautical Corp	Conqueror V-1570-F	W	12-V	D	650	2400	S L	75	800	1 5	5½x6¼	1569	6 2	150		15⅞	30⅞	64	55	025	ohc	Al S	4	BG	Sc	1 St	Ec	No	1405	6
Wright Aeronautical Corp	Conqueror V-1570-F-G	W	12-V	$G^{3,7}$	650	2400	S L	75	990	1 5	5½x6¼	1569	6 2	138		15⅞	30⅞	64	55	025	ohc	Al S	4	BG	Sc	1 St	Ec	No	1475	7
Wright Aeronautical Corp	Conqueror SL 1570-F	W	12-V	D	775	2400	2450	87	950	1 2	5½x6¼	1569	6 8		7 64	15⅞	30⅞	64	55	025	ohc	Al S	4	BG	Sc	1 St	Ec	No		

A —Air cooled
Al —Aluminum
Apl —Applied for
B —Bosch
C —Cast iron
Ch —Champion
com —Compression

D —Direct
DM —Dual Magneto
Ec —Eclipse
G —Geared
G^1 —3 2 reduction gear
G^2 —4 3 reduction gear

G^3 —2 1 reduction gear
G^4 —1 56 1 reduction gear
G^5 —16 11 reduction gear
G^6 —3 2 reduction gear
G^7 —2 3 reduction gear
H —Horizontal

Hd —Heywood
HT —Hurley-Townsend
Hy —Holley
Iv —Inverted
L —Cylinder in line
Lh —L head

M —Magneto
Ni —Nickel iron
Op —Optional
Opp —Opposed
ohc —Overhead cam
Pdg —Pending

prr —push rods and rocker arms
Rad —Radial
Rad S —Staggered Radial
S.L. —Sea level
Sc —Scintilla
Scd —Scintilla—Dual Magneto

St —Stromberg
S —Steel
Y —Yes
Var —Variable
W —Liquid cooled
Z —Zenith

* —Optional battery or magneto   Note Cylinder construction first symbol designates head second—walls or water jacket and third—sleeve, if any

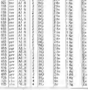
---

FLYING EQUIPMENT

Lockheed Electra Makes Its Appearance

IN AVIATION for June, 1933, the design of the Lockheed Electra, then in the preliminary production stages, was discussed in some detail During the intervening months the machine has been brought step by step through the countless processes of manufacture and test terminating in the flight trials early in March

Although the Electra in the flesh retains the basic features of the original design as far as overall dimensions type of structure, etc are concerned several details have been altered Most obvious is the rearrangement of the tail surfaces The original design contemplated a conventional horizontal stabilizer-vertical fin combination with the fin built as an integral part of the fuselage in the usual manner In the ship as produced, the vertical tail area has been divided into two smaller fin and rudder combinations mounted on the tips of the stabilizer Both stabilizer and vertical fins are entirely self supporting and free from external bracing members of any kind The construction can be seen clearly in accompanying drawing and photograph

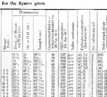


Close-up of Electra's landing gear Note how positive action both up and down is secured through the use of a worm and gear combination The normal drive is electric, with auxiliary hand control

The other changes are of a more minor nature The cockpit enclosure which originally had rearward sloping windshields has been revamped as indicated Controllable pitch propellers have also been fitted,—a feature now common to all new transport airplanes, although still in the early stages of application when the Electra was first laid down.

Many reasons for the Lockheed Electra s high speed are apparent from this photograph Note also the unconventional tail construction, an arrangement dictated not only by structural considerations but to improve controlability by placing fin and rudders in the outboard slip streams

The single spar wing in its final form has a number of interesting features Its backbone is a deep flat girder located at about ¼ chord length from the leading edge Ribs are cantilevered out from the spar fore and aft Torsional and shear stresses are taken by the skin assisted by a broad corrugated member rivetted under the smooth covering of the upper surface The corrugated inner skin tapers according to the general planform of the wing It appears to be approximately coaxial with the wing and about ¼ of chord in width Independent longitudinal stringers fastened to each rib serve to stiffen the under wing surface The single girder construction is used in the center section as well as in the tip panels Here however a box type girder with two parallel web members is used It serves as support for landing gear and engine mounts, as well as a means of transfering the wing loads to the fuselage The beam passes through the passenger cabin just aft of the two front seats



A simple and straightforward arrangement has been achieved for the retracting landing gear The shock struts, pivoted at the upper ends to the spar, carry welded steel tube forks for Goodyear Airwheels Segments of toothed wheel mesh with an electrically driven worm Details appear in an accompanying picture

Space is provided for ten passengers pilot and co-pilot and for all the features that go into the makeup of a modern transport airplane for safety, convenience and comfort Considering its carrying capacity, the Electra is usually compact, a characteristic which accounts for the 221 m p h top speed reported in the flight trial from the total of 840 hp delivered by the two Pratt & Whitney Wasp Junior engines Cruising speed is said to be in excess of 200 m p h

When tests are completed the first of the Electras is scheduled for delivery to Northwest Airways for use on high speed schedules between the Twin Cities and Chicago Pan American Airways also has several machines of this type on order

Three quarter front view of the Pobjoy Niagara showing cowl supporting ring and the center grill which forces air over the crankcase

A Power Plant
From Overseas

MANY a British lightplane record has been set by the happy combination of Lt. "Nick" Comper's "Swift" monoplane and the compact little Pobjoy engine. Other English manufacturers—Monospar, Klemm, Short and Spartan—have used Pobjoys in several of their models The basic design passed the Air Ministry's 50-hour type test in 1928 Since that time, Pobjoy-powered machines have set records between England and Australia, England and South Africa, and have twice made the difficult and dangerous Andean crossing (18 000 ft.) in South America For the first time, Pobjoy engines are now available in the United States through the Nicholas-Beazley Airplane Company, of Marshall, Mo

Three models are in current production by Pobjoy Airmotors, Ltd., the 90-hp Niagara, the 80-hp Cataract and the 70 hp Cascade All are seven cylinder radials, having the same bore and stroke, the power differences being obtained by virtue of the speeds which are respectively 3,200 r p m 2 900 r p m and 2,600 r p m The Niagara and the Cataract are both geared, the Cascade has direct drive

In many respects the design follows the lines laid down for radial air cooled engines The cylinders have steel barrels screwed into aluminum alloy heads Crankcase, gear housings etc are made of aluminum and in magnesium alloys, the former being used for the main sections and the latter for the covers. Two overhead valves are fitted per cylinder, operated by push-rods in the usual manner The crankshaft is of the single throw divided type which permits the use of a solid master connecting rod and is carried on roller bearings. Ignition is from a special four-pole, stationary contact breaker magneto running at $\frac{7}{4}$ crankshaft speed Two spark plugs per cylinder are fitted The ignition system may be shielded for radio For the fuel system, induction passages are cast integral with the rear portion of the crankcase and radiate from a common center which is warmed by an exhaust heated "hot spot" Short tubes with rubber expansion joints connect the crankcase to the cylinder heads. To prevent carburetor freezing, hot oil from the crankcase is circulated through passages cored around the throttle chamber

Reduction gears are of the double-helical type and include a shock absorber to eliminate chattering at low speeds Drives for all the auxiliary equipment are fitted on to the rear crankcase cover Connections are provided for gasoline pumps as well as for r p m. indicator and a mechanical windshield wiper. On the starboard side of the rear cover a Veeder type of indicator is sealed in by the manufacturer to record the number of engine hours operated A 60-watt, twelve-volt generator can be mounted on the rear end of the engine, driven through a flexible coupling

Outstanding feature of the Niagara engine is the complete cowling system designed to improve both streamlining and cooling A chromium-plated nose piece is supported on a tubular ring from the crankcase Deflector plates are provided between the cylinders and tied in with the cowling in such a way that all the air which enters the nose-piece is forced to circulate over the cylinder heads or around the barrels. Passages are so shaped that the airflow is at greater velocity than the speed of flight, thus making for temperature conditions better than those obtainable with a bare engine Complete cowling for the rear portions of the engine fitted up with suitable cylinder head bonnets and air scoops has been designed to tie into the nose piece The cowling has been so hinged that it can be opened up completely to give access to the engine for adjustment

The Straughan Biplane, a new light ship which carries two people with a modified Ford engine and which sells for less than $1,000

In spite of complete enclosure the Pobjoy Niagara engine is completely accessible for maintenance

	Niagara	Cataract	Cascade
Type	Geared	Geared	Ungeared
Bore	3.03 in	3 03 in	3 03 in
Stroke	3.42 in	3.42 in	3 42 in
Guaranteed power at normal r p m	84	75	65
Normal r p m	3 200	2 900	2 600
Guaranteed maximum power	90	80	70
Maximum r p m	3 500	3 200	2 850
Gear reductions	0.47 1	0 47 1	
Dry weight*	145 lb	135 lb	126 lb.
Weight of exhaust collectors	6 lb	6 lb	6 lb
Weight of cowling	10 lb		
Overall diameter	26 5 in	26 in	26 in

*Including propeller hub and cylinder deflectors but excluding exhaust collectors and cowling

A Newcomer, Under $1,000

AT A TIME when interest is centered in the developments of a light plane program under the wing of the Department of Commerce, a newcomer in this class has put in an appearance in the vicinity of Wichita This little ship is the product of the Straughan Airplane Company It is built around a modified Ford Model A four-cylinder engine, rated at 40 hp at 1,900 r p m

The machine is a conventional biplane with steel tube fuselage, wooden framed wings and fabric covering Landing gear and tail surfaces are of welded steel tubing. It is arranged for side-by-side seating for two people

At 1,400 ft above sea level, the plane has shown a top speed of 80 m p h The general specifications as given by the manufacturer are span 28 ft 6 in.; length overall 19 ft 8½ in ; weight empty, 581 lb ; gross weight, 998 lb ; fuel capacity 7 gal ; fuel consumption (cruising) 3 5 gal per hour

---

NEW VOLUMES FOR THE SHELVES

INSTRUMENT FLYING, *by Howard C Stark, Published by James Stark, Pawling, N Y , 1934, 76 pages, $2*

"INSTRUMENT FLYING" is especially written for pilots engaged in airline operation There seems to be a need for a co-ordinate system of instruction in the technique of blind flying and Mr Stark should be congratulated for publishing a book which fills this need He has wisely refrained from going into such problems as dead reckoning, drift computing, and other information which can be found in any standard book on navigation

The author has done well to include at the outset of his book a quotation from an article by P R Bassett chief engineer of the Sperry Gyroscope Company In this article an analysis is given of a body with six degrees of freedom, which shows conclusively that it is necessary to have two groups of instruments, rate and amount, in order to correlate the position of such a body to known co-ordinates An effective illustration simplifies the problem for the reader and enables him to follow this line of reasoning

Upon the arrangement of indicating devices in the cockpit Mr. Stark bases his whole method of instruction Whether or not his readers will agree that Mr Stark's grouping is the only correct one is questionable but surely all will admit that a logical system based on instruments is much more conducive to keeping the craft on an even keel than flying with a haphazard arrangement Mr Stark will have an opportunity to test the correctness of his ideas very thoroughly as he is now engaged in instructing the K L M pilots in Holland in blind and night flying

On the whole, Mr Stark's method of instruction is very graphic, and after reading this book, a young pilot will probably feel that he is able to fly an airplane for hours in any kind of weather Fortunately the author is sufficiently emphatic on the need of training practice so that a fledgeling will probably realize that proper instruction with an intelligent mentor will solve more quickly the difficulty of obtaining the S A T Rating

In the reviewer's opinion the last chapter explaining blind landing methods could be improved upon The inclusion of the landing method employing lights could well be omitted as it seems somewhat impractical and at least needs further development

EPIDEMIOLOGY IN RELATION TO AIR TRAVEL, *by Arthur Massey, H K Lewis & Company Ltd London, 1933, 59 pages $2 25 approximately*

AMONG the unexpected problems of air transport is the possible introduction of tropical disease into the temperate zone on board of aircraft making the trip from the tropics so swiftly that the normal quarantine period for the incubation of the disease would not have passed before the passengers were discharged at their destination Dr Massey treats of that danger in full, with facts and figures, with maps showing the zones where yellow fever, cholera and plague normally occur, and with tabulations of the numbers of mosquitoes that have been found upon transport planes

THE STRESSES IN AEROPLANE STRUCTURES *by H B Howard, Pitman Publishing Corporation, New York and London 1933 264 pages, $5*

FROM Genesis of Revelation, Mr Howard proceeds with dizzying speed, and if the reader is a little breathless at the end of the voyage it will not be surprising A book on stress analysis that starts with the statement "It a straight rod or bar of steel or other structural material is subjected to a pull in the direction of its length an elongation of the rod is observable," and goes straight forward from that statement by easy stages to reach the complete mathematical analysis of the elliptically-tapered strut on page 110, is hitting a pace that only the very exceptional student will be able to meet From tapered struts the trail continues through continuous beams, redundant structures and torsion Practically the first 90 per cent of the book's length is devoted to the general principles of applied mechanics and the strength of materials, with only incidental reference to airplane design Space is found for some very interesting material on graphical methods applied to beams

The last fifteen pages are devoted to aircraft stress analysis proper and are brief to the point of being casual The closest study of the chapter dealing with "The Loads Upon an Airplane" will not reveal that a load factor of more than 4 8 has ever been encountered in flight, nor is there any indication that load-factor researches have ever been made outside of Great Britain, except for a simple and unqualified statement that "extensive measurements of acceleration due to gusts have been made in America."

THE AUTOGIRO AND HOW TO FLY IT, *by Reginald Brie Pitman Publishing Corporation New York 82 pages $1 75*

MR BRIE can be defined in a single phrase as the Jim Ray of England For several years he has been diligently engaged in demonstrating the parlor tricks of the autogiro at flying fields all over the British Isles, and now he has undertaken to take the public into his confidence about how it does it.

He speaks frankly as an autogiro partisan Adopting the question-and-answer method that was used in AVIATION in April, 1931, when the editor put questions about the alleged faults and fallacies of the rotor type of aircraft and Mr Pitcairn answered them Mr Brie provides both questions and answers himself to explain the simple theory of the autogiro, the general performance characteristics and capabilities, and the technique of pilotage The chapter on flying would be a useful preliminary to a course of instruction in the air, and a useful supplement to refresh the memory after experience in the air was over for the moment, but one would hardly recommend that an airplane pilot attempt to fly an autogiro for himself with no information beyond what Mr Brie's book provides Obviously a book of 80 pages has to be limited on every heading to the briefest and, in this case, to the most elementary treatment Nevertheless the engineer who has not yet given any thought to the autogiro will find it a very useful introduction, as will the pilot similarly uninstructed in the specialty of gyrating flight The book terminates with a chapter on maintenance, but that cannot be recommended as of any particular value to American mechanical forces, as it refers entirely to the British model —of which drawings and a reasonably detailed description are given For the American, the Pitcairn and Kellett instruction books would be more useful

A Correction

ATTENTION has been called to an error which appeared in our book review columns in the February 1934 issue A study entitled "Financial Policies in the Aviation Industry" is by Professor Paul A. Dodd of the University of California at Los Angeles Westbrook Publishing Company of Philadelphia Pa., are the publishers The price is $3

THE BUYERS' LOG BOOK

AVIATION's *Card Index of New Equipment*

This department is equipped to help readers locate manufacturers of any parts, accessories or materials

---

AIRPLANE ACCESSORIES **Tie rods (catalog)**

The Macwhyte Company
Kenosha Wis

CATALOG A-5 (February, 1934) covering all types of aircraft tie-rods available on request. Products include round square, streamline (lenticular), and true streamline rods in all sizes up to and including 1¼ in diameter. Can be furnished in half-hard carbon steel or in stainless steel Catalog also contains complete engineering data on terminals, fittings and accessories

AVIATION, *April, 1934*

AIRPLANE ACCESSORIES **Tires**

Firestone Tire and Rubber Company,
Akron, Ohio

A NEW TYPE commercial non skid tread design which is available in the popular 15 00-16 and other sizes has been developed to give high braking efficiency and long wear. Weights are below the range specified by the U S Army Air Corps Made by the Firestone gum dipped process. Developed and tested in active service on two company-owned Ford transport airplanes

AVIATION, *April, 1934*

ENGINE ACCESSORIES **Push rod gaskets**

Air Transport Equipment Inc ,
Roosevelt Field, Garden City L. I , N Y

PUSH ROD GASKETS of a new type made up of a recently developed non-soluble rubber compound known as Nonsol now available for all types and sizes of aircraft engines These gaskets have been tested under a wide range of conditions by a leading airline on Wasp engines and have been found to be satisfactory Full details available on application to manufacturer

AVIATION, *April, 1934*

ENGINE ACCESSORIES **Fuel pump**

Evans Appliance Company,
Detroit, Mich

A NEW TYPE fuel pump, the E-8, is being marketed which incorporates many new features A flexible shaft connection eliminates breakage a sylphon type seal prevents leakage after long use and an internal relief valve is built in as an integral part of the pump to regulate pressure at the carburetor The pump will deliver 280-300 lb per hour free flow It weighs 2¼ lb

AVIATION, *April, 1934*

INSTRUMENTS **Indirect lighting device**

Kollsman Instrument Company
1 Junius Street, Brooklyn, N Y

IMPROVEMENT in instrument lighting and mounting announced Individual lamps (0 115 amp) easily replacable from front of board No glare or radio interference intensity controllable Applicable to planes having no battery system New instrument mounting permits quick installation and removal from front of board by removing one screw Flush mounting standard appearance

AVIATION, *April, 1934*

PARTS **Engine valves**

The Eaton Manufacturing Company
Cleveland, Ohio

THE Wilcox-Rich Division of this company has developed and marketed salt-cooled valves for airplane and automobile engines Hollow stems and heads are filled with metallic sodium for cooling Sub-licenses to manufacture these valves abroad have recently been taken by Rolls-Royce in England and Hispano-Suiza in France through the Bristol Engine Company, European licensee

AVIATION, *April, 1934*

LABORATORY EQUIPMENT **Vibration tester**

The Sperry Gyroscope Company
Sperry Building, Brooklyn, N Y

SPECIAL instrument has been developed for testing vibrating characteristics of airplane instruments or instrument boards Consists of heavy handle on which a precision indicator gage graduated in thousandths of an inch is mounted By pressing the shaft of the indicator against a vibrating body amplitudes of as little as 0 0005 in may be read directly from the dial

AVIATION, *April, 1934*

PARTS **Fastening Devices (catalog)**

Parker-Kalon Corporation
200 Varick Street, New York, N Y

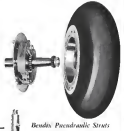
THE fourth edition of the Parker Kalon Data Book has just been issued and is available upon request. It contains specifications and technical data on various types of self-tapping screws, nails etc Although these fasteners are adaptable to a wide range of materials and uses, certain styles are particularly useful in aircraft construction for sheet metal fastenings etc

AVIATION, *April, 1934*

BENDIX

Streamline Wheels and Brakes

These wheels were developed to meet the conditions imposed by tires of a new design. This condition involved design to meet a predetermined form with a resultant maximum of strength and minimum of weight within that form. Brake development, though incidental, was along similar lines, in that maximum controllable power with minimum weight was sought. These structures are a valuable addition to the reduction of parasite in fixed landing gears.



Streamline Tail Wheel Knuckle Assembly

A series, divided into two parts, designed and built to meet Air Corps tentative standards: 8 and 10½ inch sizes steerable, as well as swivelable 360 degrees for ground handling. Larger sizes swivelable 360 degrees, but not steerable. All sizes damped to prevent shimmy. Developed by the Air Corps in the quest for reduced parasite and used with streamline tail wheels and tires.

Bendix Pneudraulic Struts

The result of more than three years of careful research. Designed in each case for the particular structure into which it is to be fitted. A development carefully worked out to give maximum shock dissipation for minimum load on the structure, and maximum comfort in taxi-ing with minimum weight. Can be designed to operate on any size aircraft, both for landing gear and tail wheel work.

Bendix Standard Pilot Seat

Developed to meet both U. S. Army Air Corps and U. S. Navy, Bureau of Aeronautics, requirements. Designed to reduce service stocks to a minimum by the use of a single seat. Utilizes latest knowledge regarding forming of aluminum alloys, the use of electric welding and of special machinery. This seat has passed all tests and weighs, completely painted, six and one half pounds, a major reduction in weight.

BENDIX PRODUCTS CORPORATION

AIRPLANE WHEEL *and* BRAKE DIVISION

SOUTH BEND *(Subsidiary of Bendix Aviation Corporation)* INDIANA

take off WITH ADDED SAFETY

THERE'S AN EXTRA MARGIN of security in Texaco Lubrication. Texaco Airplane Oils are *always* uniform, resistant to oxidation and sludging and free from the impurities which form hard carbon. You can depend on them. Texaco refining and the extraordinary care in testing *insure* their performance under every extreme of temperature change and altitude.

Texaco Airplane Oils bring that comforting assurance that oil lines are clear and that every part of your motor is receiving the effective lubrication upon which its life and your safety depend.

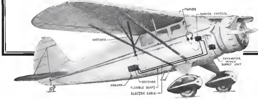
Use Texaco Airplane Oils and enjoy freedom from care, true economy and longer engine life. Texaco Aviation Products are available at principal airports throughout the United States.

THE TEXAS COMPANY
135 East 42nd Street, New York City

use TEXACO

TEXACO AIRPLANE OILS ★ TEXACO MARFAK GREASES TEXACO AVIATION GASOLINE ★ TEXACO ASPHALT PRODUCTS (for runways, hanger floors and aprons and dust laying).

RCA VICTOR
AIRCRAFT RADIOBEACON
RECEIVER AVR-2



PERMITS COMPLETE COVERAGE of all airways radio stations within range operated by the Airways Division, U. S. Department of Commerce—also Airport Radio Traffic Control Stations.

PROVIDES RADIOBEACON RECEPTION, Airways Weather Report Reception, and Traffic Control Reception.

APPLICABLE TO ANY AIRCRAFT, small or large. Remote or local control.

INVALUABLE FOR "BLIND" FLYING OR FOR POOR VISIBILITY CONDITIONS.

ALWAYS USEFUL—BUT OFTEN NEEDED URGENTLY.

Equipment packed complete in box, ready for immediate installation and connection to ship's 6-volt or 12-volt battery, as specified.

For information or demonstration, communicate with AIR ASSOCIATES, INC.

Post Office Box 333
Garden City, L. I., N. Y.
(Located on Roosevelt Field)

5300 West 63rd Street
Chicago, Ill
(Located on Chicago Municipal Airport)

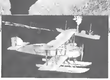
1200 Airway
Glendale, Calif
(Located on Grand Central Airport)

RCA VICTOR

RCA VICTOR COMPANY, INC.
Camden, N. J. *"Radio Headquarters"*

Round the World Anniversary

TEN YEARS OF DOUGLAS PROGRESS

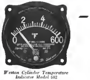


TEN years after those pioneering Douglas planes established their premature record of being the first to fly around the world, Douglas has introduced its new Transport. ℂ And here again Douglas has pioneered an entirely new standard of air transport luxury and speed. ℂ The three Douglas planes in 1924 averaged 90 m.p.h., for their flying time around the world—a remarkable record then. But on the night of February 18, last, the Douglas Transport averaged 211 m.p.h. for the 2609 miles from Los Angeles to New York, while its passengers relaxed in the luxurious comfort of its soundproofed salon. ℂ Ten years, and more, of engineering progress are behind this new luxurious master of the airways. ℂ Douglas is naturally proud of what has been accomplished, but only insofar as each succeeding advancement forms a stepping stone to even greater progress. Douglas Aircraft Company Inc., Santa Monica, California, U. S. A.

DOUGLAS TRANSPORT

TWA *Does it Electrically*

Weston Electrical Instruments on all TWA Douglas Planes: Tachometers · Cylinder Temperature Indicators Air Temperature Indicators · Oil Temperature Indicators · Carburetor Air Temperature Indicators · Voltammeters



Weston Cylinder Temperature Indicator Model 602

Weston Tachometer Indicator Model 545

– with dependable

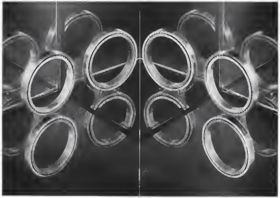
WESTON INSTRUMENTS

Just a glance at the instrument board and the pilot has accurate knowledge of engine operating conditions on these TWA Douglas Airliners. Air temperatures, oil temperature and engine speeds are indicated electrically with Weston Instruments. Thus inaccuracies due to tube leakage and weight and wear of long shafts are eliminated. Installation is easy and rapid . . . an electrical connection completes the job. And maintenance becomes a negligible item

For your planes, you will want the economies and advantages of electrical indication. Complete information on all Weston Electrical Aircraft Instruments is available. Write today Weston Electrical Instrument Corporation, 616 Frelinghuysen Avenue, Newark, New Jersey

WESTON
Instruments

Reflecting the Quality



WITH the increasing speeds, heavier loads and wider cruising range of modern planes, the quality of the ball bearings which safeguard control becomes increasingly important. When you buy Fafnir Aircraft Bearings you are assured that bearings of a known excellence—the standard of the industry—are going into your ships. You gain the service of the company with the longest and most widespread experience in the application of ball bearings to control systems. You know that your requirements will be filled with a promptness second to none.

The close cooperation with leading builders of aircraft which developed the Fafnir line, is as active today as ever. All of these features are protecting the aircraft companies that can afford no less than the best in quality, experience and service. THE FAFNIR BEARING COMPANY, *New Britain, Conn.* Atlanta . . . Chicago . . . Cleveland . . . Dallas . . . Detroit . . . Milwaukee . . . New York . . . Philadelphia

Fafnir Aircraft Booklet, "BALL BEARINGS for AIRCRAFT", describes the complete line in every detail. Copies are yours for the asking. Write us today

Reflecting Quality

FAFNIR BALL BEARINGS

• • WHERE PRECISION COUNTS

- Machinists — bending over lathes, milling machines, shapers—master workers who form just a part of that organization of craftsmen responsible for the reputation of Boeing planes. . . . Boeing Airplane Company, Seattle, subsidiary of United Aircraft and Transport Corporation.

BOEING

• BOEING HAS ALWAYS BUILT TOMORROW'S AIRPLANES TODAY

• NAVIGATION COMPASSES • NAVY STANDARD COMPASSES • SENSITIVE ALTIMETERS •

ALTIMETERS • OIL, WATER, AND CABIN THERMOMETERS • ENGINE GAGE UNIT

• TACHOMETERS • MANIFOLD PRESSURE GAGES • FUEL QUANTITY GAGE • AIR SPEED INDICATORS •

ICE WARNING INDICATORS • LEVEL FLIGHT INDICATORS • COMPASSES

Kollsman *for Precision*

KOLLSMAN SENSITIVE ALTIMETER · TYPE 76-02

The precision of the Kollsman Sensitive Altimeter was demonstrated the first time in Major James Doolittle's "blind flight" experiments in September, 1929. Its dependability under the most adverse conditions was proved in Wiley Post's "around-the-world flight." In thousands of planes it is an indispensable factor of safety.

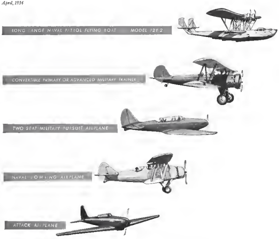
Recognizing the importance of such an instrument, the U. S. Air Services have adopted the Sensitive Altimeter as standard equipment, and the Department of Commerce requires its use on every Air Line passenger plane. Consequently, the Kollsman Sensitive Altimeter is in service on the airplanes of 25 air transport companies and it is found on the instrument panels of practically all U. S. Army and Navy planes. Foreign Governments as well as private pilots the world over are becoming increasingly aware of the outstanding qualities of this unique instrument.

It reads like a clock—the large pointer in hundreds and the small pointer in thousands. It is adjustable by a barometric pressure scale, or by markers along the altitude scale; available in ranges of 20,000 ft., 35,000 ft., and 10,000 meters; also to order in ranges of 50,000 ft. and 16,000 meters, barometric pressure scale graduated in inches or millimeters of mercury, or in millibars. Standard mounting. It combines the functions of four instruments—high range altimeter, landing altimeter, level flight indicator, climb and descent indicator. *Write for the Kollsman Catalog*

KOLLSMAN INSTRUMENT COMPANY
3 JUNIUS STREET, BROOKLYN, NEW YORK

KOLLSMAN

PRECISION AIRCRAFT INSTRUMENTS



Supremacy in the Air

Consolidated Aircraft Corporation has served the U. S. Army Air Corps and the U. S. Naval Air Service, in the design and development of its five latest types presented here .... five formidable weapons of national defense, each embodying important new discoveries in aerodynamics, in construction and in military efficiency

CONSOLIDATED AIRCRAFT CORPORATION · BUFFALO · N · Y ·

230,000

McGRAW-HILL PUBLICATIONS

American Machinist . . . for machinery and metal product manufacturers . . . business and technical magazine of the metal working industries.

Aviation . . . covers all business and technical developments in private and industrial flying including production operating and maintenance

Bus Transportation . . . for executives of transportation companies operating and maintaining buses in common carrier service

Business Week . . . gives the busy executive all important and significant business news in one publication . . . quickly . . . accurately . . . tersely

Chemical and Metallurgical Engineering . . . for the chemical engineer . . . covers production technology marketing finance economics and management

Coal Age . . . devoted to the operating technical and business problems of mining and marketing coal

Construction Methods . . . an illustrated review of current field practice and equipment used in all general and special construction activities

Electrical Merchandising . . . serves the electrical appliance trade . . . electrical retailers and wholesalers . . . helps them become better merchants

Electrical West . . . serves the specific interests both of engineering and of selling in the electrical industry of the eleven Western States

Electrical World . . . for electrical engineers . . . weekly business and technical coverage of electrical industry activities including all phases of generation, distribution and utilization of electricity

Electronics . . . industrial design engineering and manufacture of radio sound- and communication equipment Features new applications of electronic tubes

Engineering and Mining Journal . . . complete and authoritative technical and market publication of mining, milling, smelting and metal refining industries

Engineering News-Record . . . leading weekly publication of civil engineering and construction, covering news and technical performance

Factory Management and Maintenance . . . all phases of plant operation . . . management production and services including maintenance of electrical and mechanical equipment.

Food Industries . . . production operation engineering, and distribution in food manufacturing and processing plants of all kinds

Power . . . every phase in the production and transmission of power in any form, including all prime movers and auxiliary equipment

Product Engineering . . . for engineers and executives who create design, and develop machinery and engineered metal products

Radio Retailing . . . home entertainment merchandising . . . for retailers and wholesalers of radios and allied products, and their service men

Textile World . . . business and technical edited generally for the textile industries, and specifically for cotton wool, silk, rayon knit goods and processing

Transit Journal . . . engineering and business magazine of local transportation electric cars rapid transit buses trolley buses and taxicabs

McGRAW-HILL PUBLISHING COMPANY, Inc.

said "Yes!"

They'll "KEEP ALERT" in 1934
HOW ABOUT YOU?

In 1933, 230,000 key men in business and industry decided to make sure they know what's going on in their fields So they joined the thousands of others who are keeping alert by reading McGraw-Hill publications regularly To these men now comes each week or each month (as the case may be) news of the latest developments that concern them and their jobs New products, new marketing ideas, new production twists. Descriptions of the important jobs that are being done or have been done in their fields Reports and interpretations of legal, financial, political events that have a bearing on their work. All this written and edited by men whose names command respect Are you and your department heads taking advantage of a McGraw-Hill service? Or does your business news still come by the "grapevine" system . . . days or weeks or months after your competitors have read it and used it?

PUT YOURSELF AND YOUR COMPANY ON A "KEEP ALERT" PROGRAM

1934 will be a year of opportunity—for those who know how to grasp it before the other fellow Don't be left behind Resolve now that you and your employees will keep abreast of today's rapidly changing conditions—will know what to expect next by following closely what has just happened An excellent plan is for your company to adopt such a program as this

1 Follow the latest developments in your own profession, business or industry by reading regularly the leading paper in your field

2 See that your department heads read regularly publications pertaining to their jobs, whether in management or operation, production or maintenance (See list of Publications opposite)

3 Ask to have a McGraw-Hill representative explain the various editorial features and services of the publications

4 Keep in touch with the McGraw-Hill Book Company for the latest books on business and technical subjects

New York Boston Philadelphia Washington Greenville Cleveland
Detroit · Chicago St Louis San Francisco · Montreal · London

Mail the Coupon Today!

McGRAW-HILL PUBLISHING COMPANY, INC
330 West 42nd Street, New York, N Y

☐ Please enter my subscription to the following publications and bill me with the first issue

☐ Please have your Circulation Man call on me to explain McGraw-Hill Service

Or please send me, without obligation, the material checked below

☐ Sample copies of the following publications

☐ Descriptive folder of all McGraw-Hill Publications

☐ Catalog of McGraw-Hill Books

NAME

TITLE

COMPANY

ADDRESS

Indispensable

PIONEER TURN INDICATOR

Recognized as the central and most important instrument for blind flying, the Pioneer Turn Indicator instantly shows the slightest divergence from straight flight. The operation of the Turn Indicator is positive regardless of the flying position of the airplane ● With the Bank Indicator (built into the dial of all Turn Indicators), the Pilot is able to maintain a laterally level attitude while flying straight and to bank at the proper angle when turning. Write for our new booklet which illustrates and briefly describes twenty-seven important Pioneer Instruments.

PIONEER INSTRUMENTS

PIONEER INSTRUMENT COMPANY INCORPORATED

BROOKLYN · NEW YORK · A SUBSIDIARY OF THE BENDIX AVIATION CORPORATION

No Leg Straps

For women passengers in modern cabin airplanes, the problem of instantly attaching parachute equipment in a manner at once convenient and comfortable to the wearer, has at last been solved There are no leg straps to this IRVIN Chair Chute Its Lap Strap attachment, equally usable by men as well as women, is therefore uniquely applicable for general transport use

For Descriptive Folder of
"Irvin Chair Chutes," write today—

IRVING AIR CHUTE CO., Inc.

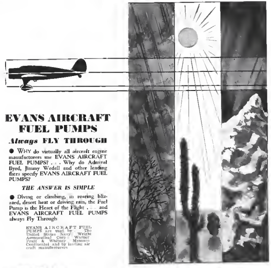
1670 Jefferson Ave., Buffalo, N. Y.

Cable Address: "Irvin, Buffalo, N. Y., U. S. A."

West Coast Factory and Office: 1500 Flower St., Glendale, Calif. Canadian Factory: Ft. Erie, Ont.

Over 800

times in 33 countries of the world, men and women have had no choice—but to leave their ships in mid-air, and have alighted safely by means of IRVIN Air Chutes Adopted as standard parachute equipment by more than 37 governments



EVANS AIRCRAFT FUEL PUMPS

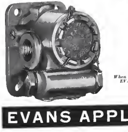
Always FLY THROUGH

● WHY do virtually all aircraft engine manufacturers use EVANS AIRCRAFT FUEL PUMPS? . . . Why do Admiral Byrd, Jimmy Wedell and other leading fliers specify EVANS AIRCRAFT FUEL PUMPS?

THE ANSWER IS SIMPLE

● Diving or climbing, in roaring blizzard, desert heat or driving rain, the Fuel Pump is the Heart of the Flight . . . and EVANS AIRCRAFT FUEL PUMPS always Fly Through

EVANS AIRCRAFT FUEL PUMPS are used by: The United States Navy Wright Aeronautical Corp. Warner Pratt & Whitney Menasco Continental and by leading aircraft manufacturers



● SIX BASIC FEATURES make EVANS AIRCRAFT FUEL PUMPS the safest, most dependable on the market

1. An exclusive sylphon seal which insures against leakage by automatically compensating for wear under long usage . . . 2. An exclusive flexible shaft eliminating all chance of breakage through misalignment . . . 3. An exclusive feature allowing the rotation of pump in either direction without changing valves . . . 4. A wabble pump by-pass designed to eliminate external line entirely . . . 5. An internal relief valve which can be adjusted to any desired operating pressure . . . 6. Extreme lightness in relation to volume

*When reliability is needed
EVANS fuel pumps
are specified*

EVANS APPLIANCE CO. DETROIT MICHIGAN


Selectiv Glide
WITH
STINSON SPEED-ARRESTERS
STEEP DESCENT WITH COMPLETE CONTROL
NORMAL LANDING
MAXIMUM 10 TO 1 GLIDE
COPYRIGHT 1934 —— STINSON AIRCRAFT CORPORATION

Just Published

Two new volumes in the series of
ENGINEERING SOCIETIES MONOGRAPHS

Fundamentals of Hydro- and Aeromechanics

Based on lectures of L. PRANDTL
Professor at the University at Göttingen, Director of Kaiser Wilhelm Institute for Flow Research
By O. G. TIETJENS
Consulting Engineer, Westinghouse Elec. & Mfg. Co.

270 pages, 6 x 9, 186 illustrations, $4.00

THE first of two volumes covering the fundamentals of hydrodynamics and aerodynamics and their applications to engineering problems. This book gives a concise treatment of hydrostatics and a more elaborate treatment of aerostatics. The largest part of the volume treats the so-called classical hydrodynamics. Another chapter discusses the basic assumptions and experimental data regarding viscosity of fluids, and from this the general equations are fully deducted. The trend throughout is to show a closer relationship between theoretical and experimental development. The books are written so that each may be used separately.

Applied Hydro- and Aeromechanics

Based on lectures of L. PRANDTL
By O. G. TIETJENS

315 pages, 6 x 9, 294 illustrations, $4.00

THIS volume begins with a discussion of the laws of mechanical similarity and the rules regarding model tests. The resistance of bodies moving through fluids is treated in detail and the important conception of streamlining is emphasized. A large part of the book deals with two-dimensional and three-dimensional airfoil theory. A special chapter covers fundamental experimental methods, methods of measuring velocities and pressures of flowing fluids, design of wind tunnels, methods of making visible flow lines, etc. A large number of valuable photographs of flow patterns are included.

See these books for 10 days on approval
Send this coupon

ON-APPROVAL COUPON

McGRAW-HILL BOOK COMPANY, INC.
330 West 42d Street, New York, N. Y.

Send me the books checked below for 10 days' examination subject to approval or return. Within 10 days of receipt I will pay for those I keep, plus a few cents for postage and delivery, and return the rest postpaid. (We pay postage on orders accompanied by remittance.)

☐ Prandtl-Tietjens—Fundamentals of Hydro- and Aeromechanics, $4.00
☐ Prandtl-Tietjens—Applied Hydro- and Aeromechanics, $4.00

Name
Address
City and State
Position
Company

(Books sent on approval in U. S. and Canada only.) Av 4-34

KIRKHAM SERVICE

Under the personal supervision of CHAS B KIRKHAM
DESIGN • DEVELOPMENT • PRODUCTION OF AIRPLANES • ENGINES • AIRCRAFT PARTS

Designers and Engineers . Contract Work . Heat Treating . Cadmium Plating and Anodizing . Machining

•

Our exceptional facilities for the production of metal parts for both military and commercial planes are now being used by leading manufacturers of service planes and by the Army Air Corps.

We offer the facilities of a large, up to date and completely equipped plant under the personal direction of Charles B. Kirkham, President, pioneer designer of aircraft and engines and originator of many widely used aircraft parts, and with a staff of experienced specialists in aircraft and engine design and construction.

It will pay you to find out how economically and efficiently Kirkham Service can meet your production needs. Let us help you in your development work, or quote you on your next contract production job. All transactions are, of course, strictly confidential.

KIRKHAM ENGINEERING & MANUFACTURING CORPORATION
FARMINGDALE, L. I.
Contractors to the U. S. Army

Don't Overlook Opportunities

Men who regularly keep in touch with the market through other channels often overlook the many opportunities that are to be found in the

SEARCHLIGHT SECTION
For Every Business Want
"Think SEARCHLIGHT *First"*

AVIATION
SERVICE SECTION

MACHINERY
MATERIAL
PARTS

and Accessories for Aircraft Manufacture, Operation and Maintenance

EQUIPMENT
ACCESSORIES
SUPPLIES

for Airport Construction, Operation and Maintenance

The First Novel About the AIR MAIL to be written by insiders

BIG FLIGHT

By FRANCIS and KATHARINE DRAKE

Porter Adams, State Airport Supervisor, Vermont, says: "As instructive a bit of aviation realism as I have ever seen in print."

George Mason, Aviation Editor, The Boston Transcript, says: "The authors have presented the airline picture clearly and accurately. It should be on the shelf of every aviation library."

George A. Wheat, Vice-President, United Aircraft and Transportation Corp., says: "It is a vivid story of the air and a fine piece of literary pioneering."

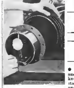
C. B. Allen, Aviation Editor, The New York Herald Tribune, says: "The book is well worth reading a second time ... a first-class bit of aviation fiction."

J. W. Brennan, General Traffic Manager, Transcontinental & Western Air, Inc., says: "One of the most interesting books I have ever read."

The New York Times Book Review says: "An adventure story brimming with a keen zest for flying. Its authors have a practical knowledge of flying and a contagious enthusiasm in writing about it. The ordinary daily routine of the airport makes interesting, even exciting reading ... a good yarn."

An Atlantic Book, $2.00

LITTLE, BROWN & CO., Publishers, Boston



FACTORY EFFICIENCY ON OVERHAULS AVAILABLE TO PRATT & WHITNEY ENGINE OWNERS

Special precision tools are used for gauging parts

● Every tool and device known to facilitate overhaul and inspection are used in the Pratt & Whitney engine overhaul shop.

In addition, all suggestions from outside shops are tested out and if proved successful are incorporated into standard overhaul procedure.

Pratt & Whitney engine overhaul service has thus been developed from the best practices of factory and field.

A Pratt & Whitney overhaul is as complete and efficient as the most modern facilities can make it.

THE UNITED AIRPORTS OF CONNECTICUT, INC.
Division of United Aircraft & Transport Corporation
HARTFORD, CONNECTICUT

Ride the Beam & Know Your Weather
Aircraft WESTPORT Radios

Westport Manufacturing Company
1214 S. San Fernando Rd., Glendale, Calif.

STANDARD AIRCRAFT FINISHES
Since 1913
TITANINE
TITANINE INC. UNION, N. J.

PROFESSIONAL SERVICES

RESEARCH
DESIGN
STRESS-ANALYSIS

MANUFACTURING
FLIGHT TESTING
OPERATIONS

GRANVILLE, MILLER & DE LACKNER
CONSULTING
AERONAUTICAL ENGINEERS
101 Park Ave., New York City

SCHOOLS

DANIEL GUGGENHEIM SCHOOL OF AERONAUTICS

Graduate and Undergraduate Courses in Aeronautical Engineering and Air Transport. Particulars from Dean, College of Engineering.

NEW YORK UNIVERSITY
University Heights, New York, N. Y.

If you use

B★A★30

BALLOON AND AEROPLANE

for your fabric requirements you will find it most economical. Its slightly higher initial cost is more than offset by savings effected on doping costs. Try a roll and be convinced!

Wellington Sears Co.
65 Worth St., New York City
Branches in leading cities

A Tight Connection All the Time

TRADE MARK
NOC-OUT
THE
HOSE CLAMP
WITH THE THUMBSCREW

Standard equipment hose clamp of the automotive and airplane industry. Your jobber has them.

4307 W. 24th PL. CHICAGO, ILL.
WITTEK MFG. CO.

IMPROVED DOPES
PHENIX CLEAR NITRATE DOPES
Clear—$1.05 per gal. in 50 gal. Drums Included
—$1.10 per gal. in 30 gal. Drums Included
—$1.20 per gal. in 5 gal. boxed cans
Pigmented—$1.90 per gal. in 5 gal. boxed cans
Yellow, Blue, Red, Green, Cream, Khaki, Aluminum, Black, White. Immediate shipments, fresh, high grade.
PHENIX AIRCRAFT PRODUCTS CO.
Willi[illegible], N. Y.

USE AIR EXPRESS FOR RUSH DELIVERIES

STANAVO

AVIATION GASOLINE
AVIATION ENGINE OIL
ROCKER ARM GREASE

Take the *front* door to Aviation

★

NO NEED to begin an aviation career with "pick-up" flying habits when you can draw upon the world's most up-to-date commercial flying experience for your training!

The manufacturing knowledge of the "United" group—the Boeing, Sikorsky, Chance Vought and Stearman airplane factories, Hamilton Standard Propeller and Pratt & Whitney—is the foundation of your ground training at the Boeing School The 60,000,000 miles of United Air Lines' mail-and-passenger transportation experience is a yardstick for all of your training. You're "*seasoned*" when you graduate!

That is why Boeing training is today's front door to the aviation developments of tomorrow. You learn all that can be learned at any flying school, with the added advantage of practical daily contacts with United Air Lines' operations.

Your copy of the current Boeing Bulletin, illustrated and fully descriptive, is ready Send for it, compare Boeing courses with any other The coupon below is for your convenience

**THE *BEST* TRAINING
SEES YOU FARTHEST**

Next regular enrollment, July 3

BOEING
SCHOOL
OF AERONAUTICS

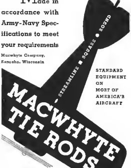
Division of
UNITED AIRCRAFT
AND TRANSPORT
CORP

BOEING SCHOOL OF AERONAUTICS
Room B-4 Airport, Oakland, California

Gentlemen: I am interested in

☐ Boeing Master Pilot ☐ Boeing Master Mechanic
☐ Limited Commercial Pilot ☐ Transport Pilot
☐ Private Pilot ☐ Special Master Pilot
(Open to holders of Transport License)

Name__________ Age____
Years in High School______ Years in College______
Address__________
City________ State______



Member Aeronautical Chamber of Commerce — Manufacturer of Progressive Aircraft Finishes

BERRYLOID CLEAR NITRATE DOPE AND BERRYLOID PIGMENTED DOPES

are standard on 1933-1934 Waco airplanes. Fine planes—fine finishes.

BERRY BROTHERS

PAINTS · VARNISHES · ENAMELS · LACQUERS
DETROIT, MICHIGAN WALKERVILLE, ONTARIO

SEARCHLIGHT SECTION

POSITIONS WANTED

AMERICAN junior executive with seven years experience all phases aviation, particularly airport management and traffic sales now with Pan American, wishes connection in United States because of health of children Write or wire PW-249 Aviation, 330 West 42d St., New York City

MANAGER ENGINEER, contract expiring in July with internationally known sport plane manufacturer Desires financial backing and guarantees to show results Willing to organize foreign manufacturing company if desired Added information or interview upon request PW-255 Aviation 520 No Michigan Ave Chicago Ill

HIGH CLASS A & E mechanic desires position in factory, airline operations or repair base Have 7 years experience in above three classes Both licenses excellent references three years Army Air Corps graduate Air Corps Technical School Conscientious worker married age 26 Go anywhere PW-251 Aviation 520 No Michigan Ave Chicago Ill

THREE years experience in all phases of air transport operations in addition to some plane and engine design and construction makes my services particularly adaptable to the smaller airlines Wish position as field manager or assistant operations manager PW-254 Aviation 330 West 42d St., New York City

YOUNG MAN must learn to fly Will do any kind of work or spectacular feat for ground and flight instructions Small salary Will go anywhere in U S A preferably out West Have had some experience on motors S S Shurley Windsor Conn Box 251

REPRESENTATIVE AVAILABLE

BUSINESS MAN pilot leaving for Orient wants to represent aircraft manufacturer RA-252, Aviation 520 No Michigan Ave Chicago Ill

FOR SALE

Motor Replacement Parts

SALE on OXX5 new parts upper case $6.50 cylinders $1.85 pistons $1.00 rings 10c, all new Aristocrat wings covered $30.00 uncovered $10.00 wire wheels 20x4 $1.00 30x5, $5.00 all new New large stock standard and oversizes Bearing rebabbitting and finishing Engines bought, sold and overhauled Write us Save 30% and 50% Save your Kinner & Warner Cylinder Heads from cracking by installing our reinforcing head studs 500 hours guarantee hundreds of successful installations $3.50 each Express your cylinders or fly in 24 hour service Air Transport Equipment Inc Roosevelt Field L I

J-5 Stearman

Excellent condition Forty hours since recovering and major overhaul Fully equipped $1,200 cash Art Chester Joliet Ill

Waco Cabin

31 model built February 32 less 350 hours, just had major just relicensed $2,280 The M C Robbins Co Waco Distributors Cleveland Airport Cleveland Ohio

NEW ENGINES PROPELLERS Kinner [illegible] exhaust $495 Used $195 Wright J-6 $995 J-5 Misc OX5 OXX6 Warner Szekely engines $85 up Hamilton standard propellers for Wright J-5 (5-7-9) J-5 Wasp Jr Continental 165 Kinner 210 price $75 up New Kinner parts 40% Koolerock parts **AIRPLANE PARTS** Travelair B-4000 (J-5) fuselage landing gear complete tail American Eagle A-129 fuselage Kinner motor mount cowling landing gear **WANTED LATE MODEL** Aeronca Monocoupe Fleet Great Lakes Bird Waco F Lycoming Stinson slightly damaged considered Complete description first letter Brewer Flying Service Buffalo

Airplanes

Waco C Cabin built July 1932 210 H P 135 hours total time 38 hours since top overhaul Equipped with radio metal propeller landing and navigation lights Heywood starter wheel pants Color fuselage black wings and trim aluminum Priced at $3,500 flyaway West Palm Beach Florida or Lambert Field Robertson Mo Wasp Ryan built 1930 Model B-7 Total time 307 hours Motor and ship in excellent condition Silver finish Six place Landing lights Special Pioneer instrument board Always privately owned and stored in private hangar Price for immediate sale $3,000 flyaway Lambert Field Robertson Mo Monocoupe Corporation Lambert Field Robertson Mo

POSITION WANTED

AERONAUTICAL EXECUTIVE

Economical management suggests employment of this executive in dual capacity Many years successful experience, million dollar projects, engineering, design, sales management, organizing, chief executive, valuable contacts Mature, sound judgment, forceful character seeking early change

PW-256 Aviation
330 West 42d St New York City

REPRESENTATIVES WANTED

Several Men with proper contacts to feature our special insurance service to the aviation industry and private owners of planes. Commission basis

FRIZZELL & COMPANY
Drexel Building Philadelphia Pa

FOR SALE

Universal Propellers

OX5 $19.95 LeBlond Velie $18.85 Szekely Continental $18.75 Sportplane boat and sled propellers $3.95 up Send 25c for Brothers bound flying manual photos and information on sensational $98.00 aeroplane Hibbs Ft Worth Texas

Ox-5 Motors

Just purchased from Government Guaranteed brand new Shipped privilege of inspection Reasonable price Grant Marine Motor Co [illegible] Whittier Detroit, Mich

Cash Sacrifice Sale

Licensed airplanes at Buffalo Waco OX 282 hours $385 Hisso Eaglerock $385 Curtiss Jr refinished $425 Rearwin Jr (new engine) $475 Alexander Fly About Cabin 2 place Eaglerock Kinner 148 hours $1,025 Eaglerock J-6-5 only 108 hours Late Travelair J-5 Eaglerock J-5 $1,150 and others [illegible] Flying Service 934 Franklin Buffalo

Kellett Autogiro

210 H P Ship and motor in excellent condition Fully equipped for sky sign towing FS-253 Aviation 330 West 42d St New York City

Waco Cabin

Continental R670 Excellent condition Extras include [illegible] steel propeller leather upholstery lights and flares 70 gallon gasoline tanks and special paint job Bargain $3,250 The M C Robbins Co Cleveland Airport, Cleveland Ohio

FOR SALE OR TRADE

Sell—Trade

Birds OX5 Kinner Eagle $750 Waco 10 $375 Lycoming Stinson $1,500 Arrow Sport Challenger Robins used airplane parts will trade Pioneer Aviation Co Airport [illegible] N Y

Arrow Sport

Leblond 65 hp Few hours perfect condition many extras including steel propeller Bendix lights skies or trade for three-place amphibian licensed or needing repairs Floyd Rowley 45?2 S Salina St Syracuse N Y

WANTED

New Challenger Engine

Wanted R-600 Must be new and at bargain price Address The Aviequip Co Rocky Mount N C

Engines

Wanted Curtiss D-12 Tore Tool Co St Clair Mich

SUPREME PROPELLER SPECIALS

New Stock

OX5	$25.00
OX5 with Travel Air spinners or 2 for $25.00	15.00
Kinner & Warner or 2 for $35.00	28.00
LeBlond 60 Gypsy & Warner or 2 for $35.00	20.00
Szekely Cirrus LeBlond 60 and Aeronca or 2 for $25.00	15.00
Challenger Hisso & Whirlwinds with or without spinner	15.00
USED PROPS	
Kinner & Warner or 2 for $20.00	12.50

Deposit required with order

THE AIRCRAFT STEEL CO
Wichita, Kansas

LICENSED AIRPLANES FOR SALE

Travelair 6 pl cabin J-6 [illegible] major overhaul Complete night flying equipment Ryan B5 6 pl brougham night fly'g equip 265 hrs Stinson Jr 4 pl J5 complete night flying equip Buhl [illegible] 3 pl sport J-5 comp eq [illegible] hrs Licensed aircraft bought sold and exchanged Terms

NATIONAL AIRLINE TAXI SYSTEM
Standard Oil Hangar 151 West 21 St
Municipal Airport [illegible] Illinois

WANTED

Large enterprise wants three or four **Wasp Powered Sikorsky Amphibians** S-38—with export A T C—Complete order of flight—Good condition—Delivery about September 1934—State lowest price—Condition equipment—Specifications—NR

W-250 Aviation
Aldwych House Aldwych London W C 2

MISCELLANEOUS

Aviation

Air-minded young men interested in entering the field of Aviation as apprentices Write enclosing stamp to Mechanix Universal Aviation Service 12583 Mansfield Dept F Detroit, Mich

BOOKS

Going to College

Working your way through? The 1934 Edition of the Student Handbook is crammed full of information on how thousands of young men and women are doing this very thing—and how You may do it too! And most important of all—how Universities assist You in Working Your Way Through College Price 25c coin postpaid Student National Advisory Board Dept F 12881 Mansfield Detroit Mich

Fly with the Army

Do you know that the U S Army Air Corps takes in over 600 unmarried men between the ages of 20 and 28 for Free Flying Training—250 solo hours $75.00 a month? Complete information on how to qualify and apply is contained in the booklet "The Army Flyer." Price 25c coin postpaid No political or social influence necessary to secure appointment Midwestern Aviation Bureau Dept F 12883 Mansfield Detroit Mich

(See additional book ad on page 33)

EDUCATIONAL

Radio Engineering

Broadcasting aviation and police radio servicing marine and Morse telegraphy taught thoroughly All expenses low Catalog free Dodge's Institute State St Valparaiso Ind

SEA AND AIR NAVIGATION
Instruction and Equipment
CHARTS MAPS SPECIAL RESEARCH NAVIGATION DATA

For Detailed Information Write to
Lieutenant-Commander P V H WEEMS
U S Navy (Ret) Annapolis Maryland

THE U S AIR CORPS takes in this year 800 unmarried men between ages of 20 and 28 for Free Flying Training Given over 200 SOLO HRS Special Uniforms Transportation to Field Living Expenses and pays each man a salary of $75 a mo The Training costs absolutely Nothing Let us tell You How to Get In Information about Uniforms, Rank, Leave and Actual Life at the New $10,000,000 Field Send Your Name [illegible] Nothing else to buy

FLYING INTELLIGENCE BUREAU
101 [illegible] Bldg Los Angeles California

It's Hard to Believe—

But These Are the

FACTS

Estimates made on the New 225 H.P. Beechcraft, prior to actual flight, were based on the performance of the 420 H P Beechcraft We estimated that this New Beechcraft would have a top speed of 170 M P H

The flight tests have now been made The speed of the ship has been clocked We are ready now to give you the actual facts *These facts are guaranteed within 2%* under standard atmospheric conditions

In every respect the performance exceeds our estimates The top speed of this New 225 H P Beechcraft is *175 M P H with a cruising speed of 152 M P H* We invite you to compare this guaranteed performance with the *guaranteed top speed* of any other four-place 225 to 260 horse power airplane

But in spite of its high speed the New Beechcraft can be landed easily and at a slow speed *It has a landing speed of 45 M P H* This is a ratio of approximately four to one

We realize these statements are hard to believe—they were hard for us to believe—but after making repeated performance tests *we know they are correct*

Specifications, descriptions, illustrations, and other performance facts concerning this New Beechcraft are included in our new catalog *Write for it*

Walter H Beech

The Beech Aircraft Company
WICHITA KANSAS

INDEX TO ADVERTISERS

✦

This index is published as a convenience to the reader Every care is taken to make it accurate, but *Aviation* assumes no responsibility for errors or omissions

Boeing School

offers

HOME STUDY COURSES
—FOR MEN IN THE INDUSTRY

Now men in the aeronautical industry can take home study courses in various phases of air line operation at nominal cost As an example, one third of the employees of United Air Lines have already enrolled for one or more of these 4 special Boeing Extension Courses

1 AIRCRAFT COMMUNICATIONS
2 AIRCRAFT POWER PLANTS
3 AIRPLANES
4 AVIGATION, METEOROLOGY and AIRCRAFT INSTRUMENTS

Each of these courses offers an opportunity to build your present capacity Each was prepared for people *already in aviation*, Prices have been purposely kept low, with extended monthly payment privileges if desired. *Write to us today, for full details, addressing*

BOEING SCHOOL OF AERONAUTICS
Extension Dept , Hangar 5,
Oakland, California

PRECISION BEARINGS

"NORMA-HOFFMANN"

WRITE FOR THE CATALOG ON PRECISION BALL, ROLLER AND THRUST BEARINGS, LET OUR ENGINEERS WORK WITH YOU

NORMA-HOFFMANN BEARINGS CORPN · STAMFORD CONN , U S A

Employment "Opportunities"

JOBS and MEN—For Plant and Office Technical Executive, Operative and Selling *See "SEARCHLIGHT"*

Equipment "Opportunities"

TO BUY, SELL, RENT and EXCHANGE—Used and Surplus New Equipment and Material—*See "SEARCHLIGHT"*

Business "Opportunities"

OFFERED and WANTED—Contracts, Capital, Plants, Properties, Franchises, Auctions — *See "SEARCHLIGHT"*

For "Opportunities" of every kind: "Think SEARCHLIGHT First" 5108

SEE THE 1934 WACO

MORE POWER • MORE SPEED • MORE ROOM • MORE COMFORT

WACO AIRPLANES

AMERICA'S OUTSTANDING CHOICE

ASK ANY PILOT

THE WACO AIRCRAFT COMPANY • TROY, OHIO


GRUMMAN AIRCRAFT ENGINEERING CORPORATION
FARMINGDALE, LONG ISLAND
Designers and manufacturers of Airplanes for the
U. S. Navy

- ★ Top speed 221 m.p.h.
- ★ Cruising speed 203 m.p.h.
- ★ 10 passengers, 2 pilots
- ★ 500 pounds of cargo
- ★ Bimotor Safety
- ★ Unsurpassed economy

THE EMPHATIC ANSWER TO AVIATION'S PROBLEM

Lockheed Aircraft Corporation, Burbank, California

European Agent: Anthony H. G. Fokker, Gen. Mgr., Nederlandsche Vliegtuigen Fabriek Fokker, Amsterdam, Holland.